REPORT OF THE WORKSHOP ON INTEGRATED COASTAL AREA AND RIVER BASIN MANAGEMENT IN THE SOUTH ASIAN SEAS REGION

Chennai, India, 7-10 April 2003

South Asia Co-operative Environment Programme

and

United Nations Environment Programme

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Note: The report has been prepared and coordinated by the UNEP/GPA Coordination Office, the UNEP/ Regional Seas Coordination Office and the South Asia Co-operative Environment Programme (SACEP).

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This report is accompanied by a CD-ROM with the PowerPoint presentations of the case studies presented during this workshop.

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Included: CD-ROM with case study presentations

EXECUTIVE SUMMARY

Integrated Coastal Area and River Basin Management (ICARM) provides the context to consider explicitly aspects of natural and socio-economic systems that have previously been seen as outside the scope of interest of policy makers and planners, concerned with only the sectoral development of river basins or coasts proper. Recognition of linkages between the two systems leads to a better coordination of policy making and action across sectors (water, forestry agriculture, urban development etc.) and geographically, ultimately leading to a more rationale use of resources and more effective environmental protection. An integrated management approach will optimize policy interventions in space and time to reduce potential conflicts, bridge potential gaps and streamline potential overlaps between policies. This will be achieved through recognition of the key linkages between the two systems (both natural processes and human activities) and identification of key locations, both geographical and sectoral, for policy intervention. ICARM employs concepts to manage the two specific areas together in an integrated manner.

While South Asia's coastal waters have some of the richest and most diverse marine species and coastal habitats in Asia, many are under threat from increasing resource exploitation, agricultural and urban development, elevated nutrient levels, increased sediment loads, and unplanned tourism developments.

UNEP, as part of their focus on integrated coastal zone management, including ICARM, and in their programme support for the SACEP's South Asian Seas Action Plan (SASAP) for 2003 agreed to support a ICARM Workshop in this region. Subsequently, the workshop was held at the National Centre of Ocean Technology (NIOT) in Chennai, India from the 7th to 10th April 2003.

The Workshop focused on introducing the ICARM concepts to the countries of South Asia and highlighted the need to develop new management structures and instruments that can take into account the intimate functional linkages between the coast and the river basin proper. Case studies from the countries in the region were presented and discussed at the workshop. The workshop further aimed at making recommendations for ICARM cases in the region, to identify potential pilot projects in the region and identify ways in which Regional Seas (SASP) and GPA could provide and support the framework for Regional Cooperation and developing Regional Strategies for ICARM. The representation at the workshop was from varied levels of Inter-disciplinary groups, viz., a) Managers of river basins and coastal zones; b) Policy Makers, Planners; c) Practical Scientists.

The following conclusions were made according to the workshop objective

a) True linking of the management of rivers and coastal areas in SAS region is at the moment more the exception than the rule;
b) Making Policies and Action Plans is not a sufficient condition for action. Planning and monitoring instruments are widely developed, but do nct deliver the expected results;

c) Creating public awareness and mobilization instruments is a key factor for successful implementation;

d) Capacity development should be promoted by sharing positive and negative experiences as cases evolve through establishing a regional and inter-regional network.

ACKNOWLEDGEMENTS

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Dr. Arvind Anil Boaz
Director General, SACEP

1. Introduction

Integrated Coastal Area and River Basin Management in South Asia

While South Asia's coastal waters have some of the richest and most diverse marine species and coastal habitats in Asia, many are under threat. Most of the coastal communities depend on the sea for their livelihoods, and many of the people living in these communities are vulnerable to – or living in – poverty. Increasing resource exploitation has had a marked effect on South Asia's coastal zones and watersheds. Direct pressure on these areas from agricultural and urban development is increasing. Indirect pressures include elevated nutrient levels, increased sediment loads, and changes in coastal configurations. Additionally, unplanned tourism developments that contribute to environmental degradation continue to be detrimental to coastal ecosystems.

With increasing population and economic demands on coastal resources, more people are generating at least part of their livelihood from activities that directly affect the coastal environment. Food, medicines, building materials, and resources for income generation are drawn from the environment. The way in which coastal resources are used create conditions that further degrade the environment, causing livelihoods to become more vulnerable and poor people to be more marginalized from lack of access to resources.

UNEP in their programme support for the South Asian Seas Action Plan (SASAP) for 2003 agreed to support the conduct of a workshop on Integrated Coastal Area and River Basin Management (ICARM) to discuss and address these issues and select possible ICARM pilot projects in the region. In order to encourage the use of regional facilities the workshop was conducted at the National Centre of Ocean Technology (NIOT) in Chennai, India from 7–10 April 2003. UNEP provided funding for the workshop.

The workshop was jointly organized by the UNEP Regional Seas Coordinating Office, Nairobi Kenya, the UNEP Global Programme of Action for the Protection of the Marine Environment from Land-based Activities Coordination Office, The Hague Netherlands (GPA), the South Asia Co-operative Environment Programme (SACEP), Colombo Sri Lanka and the National Centre of Ocean Technology, Chennai India (NIOT).

The overall goal of the workshop was to train potential and actual middle level managers of river basins and coastal areas in SAS countries in the concepts, tools and processes of integrated river basin and coastal area management.

Specific objectives of the workshop were:

- To raise awareness of the link between river basin and coastal area issues
- To raise awareness of the benefits of integrated management of river basin and coastal area
- To identify key management elements for the ICARM approach

- To make recommendations for ICARM cases and identify potential pilot projects in the region
- To raise awareness of the international initiatives for collaboration and information exchange on ICARM
- To identify ways in which Regional Seas (SASP) and GPA could provide and support the framework for Regional Cooperation and developing Regional Strategies for ICARM

The target group for the workshop was composed of:

- Managers of river basins and coastal zones
- Policy makers, planners
- Target organizations: administrations, ministries

The approach to the workshop was as follows:

- Presentation and discussion on UNEP's ICARM programme and the principles of ICARM, management instruments and management processes
- National Reports on the ICARM situation and presentations of cases from each country
- Intensive discussion on these freshwater-coast cases and examination of possibilities of an ICRAM Pilot Project in the region
- A field trip connected to a practical ICARM case
- Presentation on the main thematic subjects arisen during the workshop (Legal and Political aspects, financial and incentive structures, organizational framework, conflict resolution etc).

The steering group consisted of Martin Adriaanse (UNEP/GPA), Ellik Adler and Hanneke Van Lavieren (UNEP/Regional Seas), Prasantha Dias Abeyegunawardene (SAS Secretariat), and Dr. B. R.. Subramanian (Host organisation NIOT in Chennai).

2. Short Report of the Workshop

Workshop

The UNEP workshop on Integrated Coastal Area and River-basin Management (ICARM) for the South Asian Seas Region was held on 7-10 April 2003 at the National Centre of Ocean Technology (NIOT) in Chennai, India. The workshop was organized by the South Asia Co-operative Environment Programme (SACEP), UNEP/Regional Seas Coordination Office (RSP), UNEP/GPA Coordination Office and NIOT. The facilitation of the workshop by NIOT was excellent.

The workshop was attended by managers, policy makers/planners and scientists in the field of ICAM/ICARM: 3 participants from Bangladesh, 12 from India and 6 from Sri Lanka. Also the South Asian Seas Programme, UNEP/RSP, UNEP/GPA, the Coastal Zone Management Center (CZMC/RIKZ) in the Netherlands and the UNEP Collaborating Centre for Water and Environment (UCC-Water) in Denmark were represented.

Opening session

During the opening session the meeting was addressed by Mr. Mahboob Elahi, Director General of SACEP and Mr. Martin Adriaanse, UNEP/GPA Coordination Office. Mr. V. Sampath, ICMAM Project Directorate, welcomed the meeting. Prof. M. Ravindran, Director, NIOT made the Inaugural Address. Finally the meeting was addressed by Dr. B. R. Subramanian, Department of Ocean Development, New Delhi and by Dr. V. Krishnamurthy, ICMAM Project Directorate.

Workshop programme

After the opening session the programme of the workshop was as follows:

- General presentations were given on ICARM
  - UNEP's ICARM programme since 1995 (Ms Hanneke van Lavieren, UNEP-RSP)
  - ICARM issues and last years achievements (Mr Mogens Dyhr-Nielsen, UCC-Water)
  - ICARM Guiding Principles (Mr Martin Adriaanse, UNEP/GPA)
- The participants presented 8 Case studies from the 3 different countries. The cases were discussed in detail and recommendations were made for further actions
- Appointments have been made about reporting of cases, selection of pilot projects, and further follow-up in regional context
- A presentation was given about the Large Marine Ecosystems project in the Bay of Bengal (FAO; Ms. Philomene Verlaan)
- A general discussion on specific ICARM issues, in relation to the region was held on the last day
- On the 3rd day of the workshop a field trip was held to 2 relevant sites for Integrated Coastal and Marine Area Management (ICMAM) along the Chennai coast.

ICARM cases

Participants have presented eight cases:

1. Integrated Water Resources Development and Management of Krishna and Godavari Basin by Mr. V. K Jyothi - India
2. Experiences of Water Resources Management By Mahaweli Authority of Sri Lanka by Mr. Peter Samaraweera – Sri Lanka
3. Integrated Management of Rekawa Coastal Lagoon Area, River Basin of Kirama-Oya in Sri Lanka by Mr. R. D. A. B. Samaranayake – Sri Lanka
4. Integrated Approach to Minimise the Impact of Land Based Activities at Godavari Basin by Mr. M. V. Ramana Murthy - India
5. Integrated Coastal Resources Management Approach: A Management Tool for Coastal Habitat Management Experiences of Managing the Coastal Wetland of Negombo by Mr. Anil Premaratne - Sri Lanka
6. Integrated River Basin Management – A Pilot Project for Downstream of the Kelani River of Sri Lanka by Ms. L. Batuwitage - Sri Lanka
7. Integration of River Basin and Coastal Processes in the Restoration of Chilika Lagoon by Mr. A. Pattnaik - India
8. Coastal Zone Policies and Livelihoods in Bangladesh: A Case Study of Polder 55/1by Mr. Mazibur Rahman Miah – Bangladesh

It was agreed to include in the workshop report abstracts of the cases as well as the power point presentations.

Pilot Projects

A few pilot projects from the SAS region could be included in the ICARM pilot projects programme.

The goals of ICARM pilot projects are threefold:

- To develop demonstrations of good ICARM implementation
- To support countries with implementation (fund raising, expertise)
- The lessons learned are used for regular review of ICARM guiding principles

As criteria for cases to be selected as a pilot project has been chosen:

a) Clear freshwater-coast issues should exist
b) Countries themselves should propose and support the project
c) Pilot projects should be implemented according to the code of practice (guiding principles) as agreed under the ICARM programme

Workshop Discussions

Information exchange

The workshop discussed the role of information exchange concerning ICARM. Some conclusions:

- The role of information exchange and transparency of information is essential for confidence building and public participation. This is even more important as these days the management of river basins or coastal areas is no longer a government's affair: stakeholder involvement and public participation in decision making is a common good.
- It is important to translate scientific, management information with high relevance and make it available to stakeholders / general public in a form they can understand. Different categories, such as policy makers, managers, scientists and people at the grassroots speak different languages and often hardly communicate and understand each other.
- In trans-boundary cases information should be made available in country languages (bi- or multi-lingual information platforms, etc). The same is valid for national cases with different state languages.
- It is important to make information about cases available in an easily accessible way, as well as experiences with developments in the cases and future pilot projects. The role of UNEP and SACEP websites will be examined and an information strategy (website strategy) will be proposed in the workshop report.

Regional Strategies for ICARM

The following conclusions/recommendations were made according to the workshop objective "Identify ways in which Regional Seas, SACEP and GPA could provide and

support the framework for Regional Cooperation and developing Regional Strategies for ICARM".

a) It was agreed that Regional Seas is the excellent carrier of GPA/ICARM implementations.
b) This workshop is seen as a first step in establishing a framework for regional cooperation on ICARM as it provides for
   - An inventory of cases where the linkage of river basin and coastal area management is to be envisaged,
   - Discussion of these cases amongst country representatives and examination of possibilities for some pilot projects.
c) The workshop report and further follow-up (involvement of cases in web-site, preparation of pilot projects) is the next step in strengthening the network cooperation.
d) Striking similarities were noticed between the coastal lagoon cases of Chilika, India and Songkhla, Thailand. Closer contacts and possibilities for twinning between those will be developed in the near future.
e) A second SAS regional workshop in one or two years would be useful to exchange the regional ICARM experiences. It could more carry out a broader inventory the regional ICARM cases, examine developments in the presented cases and examine the progress made with pilot projects to be established.
f) Concrete proposals for ICARM elements in the Regional Strategic Plan could be provided by the workshop report.

Workshop Conclusions

Some more general conclusions as presented during the workshop will be open for discussion and further elaboration amongst participants until the final workshop report:

a) True linking of the management of rivers and coastal areas is at the moment more the exception than the rule, while linking the two fields is clearly feasible. It is most of all the coastal ecosystem management that will benefit from an ICARM approach. It is especially acts and legal authority, which shall allow for efficient linking, cooperation and decision-making. Both coastal and river interests should be included in water resources committees.
b) Making Policies and Action Plans is not a sufficient condition for action. Planning and monitoring instruments are widely developed, but do not deliver the expected results. Local focus delivers results, not national – or regional – plans as such. Governments – and NGO's – are powerless in Natural Resources Management without mobilization and participation of the involved people.
c) Creating public awareness and mobilization instruments is a key factor for successful implementation. People must be involved in both plan and implementation and contribute with their own resources. People need tangible results quickly and see concrete benefits to take participation serious.
d) Capacity development should be promoted by sharing positive and negative experiences as cases evolve through establishing a regional and inter-regional network. It is important to identify interesting ongoing cases in each country,

develop demonstration projects preferably with low external funding, and build partnerships and twinning arrangements.

3. General presentations

3.1 Integrated Coastal Area and River Basin Management (ICARM) and the United Nations Environment Programme (UNEP)

Presented by Ms. Hanneke Van Lavieren, Regional Seas Programme

Background– developments after Rio, 1992

UNEP and the Priority Actions Programme Regional Activity Centre (PAP/RAC) of the Mediterranean Action Plan have been implementing, since 1993, a number of joint activities within the Regional Seas Programme. Most of those activities have been oriented towards the implementation of Integrated Coastal Area Management (ICAM), as a result of the application of the provisions of the Agenda 21 adopted at UNCED in Rio in 1992. UNEP and PAP/RAC developed the Regional Seas Publication on: "Guidelines for Integrated Management of Coastal and Marine Areas" in 1995, with special reference to the Mediterranean Basin.

In 1996, the Oceans and Coastal Area Programme Activity Centre (OCA/PAC) and the Fresh Water Unit of UNEP merged to become the Water Branch. This merger was a critical move in the realization of the need for a holistic and comprehensive approach to achieve sustainable development within a watershed area. As a result of their merger, the two sub-programmes brought four critical programmes together, namely, the Environmentally Sound Management of Inland Waters (EMINWA), the Global Environment Monitoring System/Water (GEMS/WATER), the Integrated Coast Area Management (ICAM) within the framework of the Regional Seas Programme, and the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA).

Subsequent to this development, an Expert Group Meeting on ICAM (Split, January 29-31, 1996) reviewed the relationship and crucial aspects of Integrated Coastal Area and River Basin Management. The meeting undertook an analysis of the concept and drew up an initial comparative analysis of the relationship and essential aspect of Integrated Coastal Area and River Basin Management (ICARM). It is from this meeting that the initiative for the preparation of Guidelines for Integrated Coastal Area and River Basin Management evolved.

UNEP has been taking an integrated approach to management of ocean and coastal areas under the Regional Seas Programme, and to river/lake basins and aquifers under the Environmentally Sound Management of Inland Waters (EMINWA) programme. Both of the programmes have extended their scope to take multi-sectoral and integrated approach, evolving from the traditional sectoral management of target resources or for simply achieving economic goals. Through this process, both of the programmes have gained more recognition for a need to manage both river basins and coastal areas in an integrated manner, on the basis not only of their hydrological

and geochemical relationship but also of needs for a more effective socio-economic development of the two management units, which were conventionally managed separately. In this way, based on the hydrologic and geochemical relationship between the coastal areas and river basins, and from the perspective of optimal and sustainable economic development, a concept of Integrated Coastal Area and River Basin Management (ICARM) has been formulated.

Through the guidance of four Expert Working Group Meetings (May 1997 in Nairobi, January 1998 in London, December 1998 in Geneva, March 1999 in London,) UNEP Technical Cooperation Branch and Priority Actions Programme Activity Centre (PAP/RAC) of the Mediterranean Action Plan have jointly developed and published the Conceptual Framework and Planning Guidelines for Integrated Coastal Area and River Basin Management in 1999. The guidelines provide a conceptual framework to evaluate the need for ICARM case by case and a flow chart to implement an efficient and effective programme. These guidelines include a proposed conceptual planning process for ICARM, and promote, among others, participation of different levels of stakeholders in this process and use of strategic economic and environmental assessment.

The Concept of ICARM

ICARM aims at promoting sustainable development including the maintenance of all ecological processes, life support systems, and biological diversity, while providing communities with a basic healthy quality of life and reducing their vulnerability to hazards. It focuses on the sustainable production of goods and services, required by society and the resolution of conflicts in resource allocation for the production of these goods. ICARM encompasses the watershed area and the adjacent coastal stretches and takes into account ecological, economic, social and cultural aspects of this area at various levels of governance. It is action oriented in nature, continuous and adaptive in time and participatory *vis-a-vis* public and private stakeholders.

River basin management stems from a water resources management perspective, and a particular focus was placed on flood control and water supply. In recent years, more consideration has been given to protection and management of the environment, including aquatic and associated biological resources and diversity. On the other hand, the coastal areas were planned and managed from the perspectives of marine resource management and land-use planning for the coastal strips. Therefore, ICARM should be built upon these two different perspectives and approaches taken in two management efforts.

ICARM provides the context to consider explicitly aspects of natural and socio-economic systems that have previously been seen as outside the scope of interest of policy makers and planners, concerned with only the sectoral development of river basins or coasts proper. Recognition of linkages between the two systems leads to a better coordination of policy making and action across sectors (water, forestry agriculture, urban development etc.) and geographically, ultimately leading to a more rationale use of resources and more effective environmental protection. An integrated management approach will optimize policy interventions in space and time to reduce

potential conflicts, bridge potential gaps and streamline potential overlaps between policies. This will be achieved through recognition of the key linkages between the two systems (both natural processes and human activities) and identification of key locations, both geographical and sectoral, for policy intervention.

Case Studies and Demonstration Projects

UNEP (Technical Cooperation Branch) and PAP/RAC organized a workshop on Integrated Coastal Area and River Basin Management in Toulon, 10-12 January 2000. During the workshop, five case studies on the ICARM approach were presented:

1. Krka River Basin and the Adjacent Coastal Areas (Croatia)
2. Watershed Area of the Rhone River and Its Adjacent Coastal Area (France)
3. Penang Island (Malaysia)
4. Lower Limpopo River Basin and its associated coastal area (Mozambique)
5. Cetina River basin and its associated coastal area (Croatia and Bosnia and Herzegovina)

In order to demonstrate the usefulness and applicability of the "Conceptual Framework and Planning Guidelines for Integrated Coastal Areas and River Basin Management", demonstration projects were proposed.

First Demonstration project: River Cetina in Croatia

The River Cetina in Croatia was selected as a concrete project to show how the guidelines could be implemented. Further, the project expresses: the needs of the Government of Croatia for addressing environmental and socio-economic issues in the River Cetina basin and its associated areas by applying the planning guidelines (i.e. preparation and development of the environmental and socio-economic profile as an expected output of the first phase of the project); and the needs of the Government of Croatia and of various levels of stakeholders for becoming familiar with the integrated approach to coastal areas and river basins and with the potential tools (i.e. preparation and development of the environmental management plan as an expected output of the second phase of the project). The expected results of the project are: (i) enhanced knowledge of benefits that various stakeholders can enjoy by taking an integrated approach to coastal areas and river basins; and (ii) demonstrated usefulness of the planning guidelines for integrated coastal area and river basin management under a specific environmental setting.

Demonstration Projects in Asia

EARCA (Regional Centre for Graduate Study and Research in Agriculture) and CIRAD (Centre de coopération internationale en recherche agronomique pour le dévéloppement), through the international network RITME (Network for Tropical and Mediterranean Island and Coastal Sustainable Development), organized a working meeting in November 1999 in the Philippines, and agreed to set up and manage a regional project on ICARM, focusing on local community development. This regional

project would be composed of identified demonstration sites in four countries within the Southeast Asian region. These sites would be used as ICARM demonstration in collaboration with SEARCA and CIRAD partners.

A workshop on Integrated Coastal Area and River Basin Management in Southeast Asia was conducted in Phuket, Thailand during 27-29 November 2000 by UNEP (Technical Cooperation Branch), CIRAD and Coastal Resources Institute (CORIN), Prince of Songkla University. This workshop was also attended by national government representatives. In this workshop, information on the four demonstration sites was exchanged for the purpose of preparing a demonstration project proposal for funding to be considered by GEF, FFEM and other donors.

Recent developments

At the World Summit for Sustainable Development (WSSD), Johannesburg, 2002 a new impulse has been given to ICARM by the launch of the FreshCo partnership, a so-called Type II partnership on 'Linking Integrated Water Resources Management and Integrated Coastal Zone Management'. The partnership is lead by the UNEP Collaborating Centre for Water and Environment (UCC-Water), Denmark and the UNEP Coordination Office of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (UNEP-GPA). Some twenty international and national organisations, institutions and ministries joined the partnership and more showed their interest. A partnership website has been opened under www.ucc-water.org/FreshCo. The first meeting of the partnership was held in Copenhagen, October 2002.

The first FreshCo partnership activities took place early 2003. A stakeholder workshop was held in January 2003 at Songkla Lake, Thailand, where eight ICARM cases from different parts of the world have been presented and discussed. The workshop was also a preparation for an ICARM session at the Third World Water Forum, Kyoto, March 2003.

3.2 Linking Freshwater Resources Management with Coastal Zone Management

Presented by Mogens Dyhr-Nielsen, UCC-Water

Introduction

Context

The terms Integrated Water Resources Management (IWRM) and Integrated Coastal Zone Management (ICZM) are increasingly appearing high on the international agenda, following the declarations from United Nations Conference on Development and Environment in Rio de Janeiro and Agenda 21 in 1992. The concepts and general principles within IWRM (based on the Chapter 18 of the Agenda 21 on fresh water) are now fairly well known and are being consistently promoted, for instance by the

Global Water Partnership and its regional arms. The principles have been restated and elaborated at major international conferences in Harare and Paris, 1998 and by the UN Commission on sustainable Development (CSD) at its Rio follow-up meeting in 1998. The World Water Forum in Hague in March 2000 further consolidated the principles, and a "ToolBox" on best practises and experiences is now being developed.

A parallel development is ongoing regarding approaches for coastal zone management which similarly has its offset in the Agenda 21 namely the chapter 17 on *Protection of the Oceans, all kind of Seas, including Enclosed and Semi-enclosed Seas, and Coastal Areas and the Protection, Rational Use and Development of their Living Resources.* In its recommendations, this chapter calls for the promotion of adaptable and flexible processes of integrated coastal and marine management (ICAM). However, there is still found a number of different perceptions, which ranges from ICZM in a purely hydrodynamic context to ICZM as the physical planning of the land allocation and use in a coastal fringe and to the management of the use, conservation and protection of the coastal ecosystems.

The development of modern approaches within these two natural resources management areas is taking place in basically different scientific environments, as freshwater and marine science and management traditionally are covered by different institutions. However, the freshwater resources play an important role in the coastal environment (and some opposite examples also exist). Thus, there is a need to clarify and harmonize resource management approaches taking account of this important interface.

UNEP's mission is to provide leadership and promote partnerships in caring for the environment. With respect to coastal ecosystems, the management constraints mentioned above have been addressed in the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA), in the Regional Seas Programme and in the Global International Waters Assessment (GIWA). Realising the necessity of overcoming the gap between the freshwater and coastal zone management, UNEP has been working with developing concepts and mechanisms for a linked management of the "continuum" from freshwater over the coastal zone to the ocean under the title "*Integrated Coastal Area and River Basin Management (ICARM)*". Thus, concepts and guidelines[1] are being developed based on a number of pilot and case studies. Substantial progress has been made in understanding – and even modelling – the hydrological, oceanographic and environmental processes in the coastal zone, including the links between rivers and coastal waters. But there is a substantial need for further efforts, particularly in relation to development of more integrated and effective management mechanisms.

The purpose of the present paper is to make a presentation of a number of concepts and issues within IWRM and ICZM and in particular focus on those dealing with the links and the interfaces between fresh water and coastal water.

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1 UNEP / MAP / PAP: Conceptual Framework and Planning Guidelines for Integrated Coastal Area and River Basin Management. Split, Priority Action Programme, 1999.

Definitions

Water resources – or actually *fresh*water resources – are defined with reference to the topographic river catchment and its groundwater aquifers. The river management geographically ends where it joins the ocean at the coast. The notion of marine "water" resources – in traditional terms basically *fish* – is related to an ocean or sea and the limitation of such body by the coastline is also apparently clear.

But in between the freshwater catchment and the marine water, there is a "transition zone" which could be termed the coastal aquatic environment. In this context (without interfering with the longstanding debate on the delimitation of the coastal zone), it is proposed to define this coastal area as that geographical area where there is a *primary* interaction "land to sea" or "sea to land", seen in the perspective of human activities and their impacts on the aquatic ecosystems.

Water Issues in River Basins and Coastal Zones

In order to examine the links between the management of river basins and coastal zones it is necessary to consider the major aspects and issues within each domain. Subsequently, the physical and causal links are the basis of the examination of the management links. In the following some major issues for IWRM and ICZM are summarized. It will be noted that there is a clear element of similarity between the issues as causes and effects are similar in nature, but relate to different settings.

Freshwater Issues

In the river basins, the main water issues comprise:

- Increased pressure on the freshwater resources. The growth in population, economic activity and standard of living pursued by countries around the world, lead to increased competition for and conflicts over the limited freshwater resources. Situations of extreme poverty do also increase pressure on water resources since the overexploitation of soil and forestry resources and the lack of pollution control measures have a negative impact on water quantity and quality.

- Proliferating water pollution. Pollution of fresh water is inherently connected with human activities In addition to serving a basic consumptive requirement of biotic life and industrial processes, water also serves as a sink and transport mechanism for domestic, agricultural and industrial waste causing pollution. Deteriorating water quality caused by pollution threatens human health and the functioning of aquatic ecosystems and adds to the competition for water of adequate quality.

- Inadequate access to drinking water. Although all countries give first priority to satisfaction of basic human needs for water one quarter of the world's population is without access to safe drinking water and half of the population is without access to adequate sanitation.

- Provision of water for food for the growing populations. Irrigated agriculture is already responsible for more than 70% of all water withdrawals (more than 90% of all consumptive use of water). Even with a rather low estimated need of 15-20% additional irrigation water over the next 30 years serious conflicts are likely to arise between water for irrigated agriculture and water for other human and ecosystem uses.

- Maintaining productive ecosystems. Ecosystems provide a range of benefits including such products as timber; fuel wood and medicinal plants and constitutes wildlife habitats and spawning grounds. Approaches to management of water resources must ensure that vital ecosystems are maintained and that adverse effects on other natural resources are considered and where possible ameliorated.

- Variability in water availability. Almost all fresh water available for human use originates from precipitation, which varies immensely in time and space. The tropical and sub-tropical regions of the world are characterized by huge seasonal variations in rainfall often compounded by dramatic annual variations as well. Such variability increases the demand for development of water resources infrastructure and management of the water resources manifold.

- Flood and drought management. Climatically determined variations in water flows and groundwater recharges are among the causes of potential catastrophic effects in terms of droughts and floods that may lead to large-scale loss of human life and economic and environmental damage. Diseases caused by pollution of water are another set of risks, which also affects economic development.

Coastal Zone Issues

In the coastal zone typical issues comprise:

- Increased pressure on land and other natural resources - The growth in population, migration towards coastal areas and economic activities, lead to increased competition for and conflicts over the land and natural resources such as coastal fish and mangroves. Situations of extreme poverty do also aggravate the situation.

- Proliferating water pollution - Pollution of coastal waters is inherently connected with human activities. Although the assimilative capacity of the coastal waters is usually rather large compared to sewage discharges, adverse effects on ecosystems will often happen in cases where treatment and discharge points are deficient. In particular, inadequate sewage disposal can create serious problems for the tourist industry.

- Maintaining favourable shoreline morphology - Transport of coastal sediments along the shoreline, erosion and other changes can bring about serious effects on infrastructural elements and property. Harbours, navigation channels, landing sites and the associated activities and investments can be gravely affected.

- Maintaining productive ecosystems - Ecosystems provide a range of benefits including, fish, timber and fuel wood from mangroves and medicinal plants and constitutes wildlife habitats and spawning grounds. Ecosystems such as coral reefs are very important to for instance tourism. Approaches to management of coastal zone resources must ensure that vital ecosystems are maintained and that adverse effects on other natural resources are considered and where possible ameliorated.
- Natural hazards management - Meteorologically determined variations in coastal water level together with tidal variations are among the causes of potential catastrophic effects in terms of floods that may lead to large-scale loss of human life and economic and environmental damage.

The Interface between Freshwater and Coastal Zone Management

The interfaces between the management of river basin issues and coastal zone issues will naturally be focussed in the areas surrounding river mouths, estuaries and delta areas. Impacts will occur in the coastal waters from the river and have an impact area the size of which will depend on the physical and biological characteristics. In the same way changes in coastal water levels and sediment deposition patterns will have an area of influence reaching upstream into the river. The following sections describe some typical examples of physical and biological links between a river basin and a downstream coastal zone.

The examples deal with two cases:

1. River basin impacts on coastal zone issues through changes in streamflow, water quality, sediment transport and floods, and
2. Coastal zone impacts on river basin issues through tides, storm surges and coastal sedimentation

River Basin impacts on Coastal Zones

River discharge

The regime of river discharges has a profound effect on the salinity conditions in the river mouths, estuaries, delta areas, lagoons, mangroves and coastal wetlands. Persistent alterations in low flows and flood situations may bring about significant changes and impacts on ecosystems.

Decrease of river flow due to river basin development or land use changes will affect the lower reaches and cause increased tidal reach inland along with increased saltwater intrusions. If the salinity increase persists permanent damage can be done to agricultural land, specialized ecosystems and wildlife habitats. This again negatively affects the livelihoods of communities in the affected areas. Also, intakes for water supply to the coastal population can become invaded by saline water.

Water quality

The quality of the river water in the lower reaches is a result of the basins soil quality, land cover, and – in particular – the human activities along the river. If river water is

biologically or chemically contaminated it will have highly negative impacts on the health of coastal communities and ecosystems.

Deterioration of water quality can have multiple causes, most of which are related to human activity. Insufficient treatment of sewage water from urban communities, polluted discharge from industries, mining activities, oil extraction, injudicious use of pesticides and fertilizers are just some sources of freshwater pollution. Often, persistent contaminants from sources far from the main stream may eventually end up in the downstream part of the river.

The nature and level of pollutants determine the harmful effects of the water. If the river is organically polluted it may not pose direct threats to coastal communities, but it can have serious effects on the coastal ecosystems, cause algal blooms in the coastal waters thereby destroying valuable marine resources.

Sediment transport

Often rivers carry heavy sediment loads, in particular if the basin is suffering from inappropriate land use and erosion. In the coastal zone the sediment will settle in the deltas and estuaries. Here the deposited material is the basis for productive ecosystems (mangroves, mudflats, seagrass beds). In many regions the finest silt, which is washed out to the sea supports very productive pelagic ecosystems. But excessive sediment load may also have detrimental effects through eutrophication and subsequent alteration of the coastal ecosystems.

In other areas sedimentation in the coastal areas tends to block estuaries and river mouths and cause relocation of the main river channel. This creates serious problems for coastal communities in terms of town locations, navigation, etc., and destroys productive ecosystems.

Floods

The effect of river floods on coastal areas is normally damage to urban housing, roads, bridges and other infrastructure in towns. They can give rise to serious health problems when sewage systems and water supplies are interrupted and when stagnant pools of heavily polluted water are formed. Floods often destroy the low-lying agricultural land in coastal areas by topsoil erosion or depositing unfertile sediments. And they may cause significant chocks to the coastal ecosystems.

Coastal Zone Impacts on River Basins

Increase in river water levels due to tides

The upstream effects of tides are related to flooding and saltwater intrusion in deltas. Saltwater penetrates into delta watercourses and may flood low-lying delta lands. The lower the upward gradient of the delta is, the more pronounced are these effects. The coastal ecosystems will have adjusted to this cyclical effect, but alterations of the coastal morphology may lead to saltwater intrusion further inland (accentuated at times where river flow is reduced due to drought or excessive consumptive use upstream). Such situations will have adverse effects on the near inland ecosystems.

Storm surges

Under storm surge conditions seawater often flood vast land areas, not only those adjacent to deltas or riverbanks. Seawater penetrates far inshore and often destroys crops, livestock, infrastructure, and housing and may cause numerous casualties. The effects are often long-term, as damages are sometimes not overcome before the next storm surge event and agriculture land is salinized. If storm surges occur at times of spring tides and coincides with heavy and persistent rainfall in the river basin very serious flooding and damages can be the result. In some regions, characterized by very flat and low relief will experience aggravated damages.

Material transport along coastlines

Transport of material i.e. erosion, transport, sedimentation, re-suspension phenomena along shorelines affect all coastal states. Enormous amounts of material take part of this process. Material, which sediments in estuaries and block these can cause flooding upstream in rivers and prevent or disturb navigation into these.

Harbour, pier constructions and other physical alterations may change these patterns and cause relocation of river mouths, severe land-losses etc. This can seriously disturb communities in delta areas, hamper migrations of fish into or out from rivers, impede navigation and thus gravely affect livelihoods of people living upstream.

Natural Resources Management Framework

Integrated River Basin and Coastal Area Management (ICARM) is a particular case of natural resources management. Accordingly, some common fundamentals apply.

Successful natural resources management is to a very large degree related to the proper management of people – the stakeholders – and their actions. As such, it is a field for political, legal, and social considerations, much more than for the natural sciences. An understanding of the hydrological and biological conditions is important, but only useful if it is combined with a similar understanding of the political and social conditions.

Generally speaking, there are three significant stakeholder groups:

1. The authorities – at national, regional and local level – who have the overall responsibility to mind the public interests of the resource
2. The users – local inhabitants, private business, etc. – who extract personal benefits from the resources
3. The supporters – researchers, extension people, NGO's, etc – who assist both authorities and users in specific tasks.

An efficient management system aims at involving the participation of these stakeholders in achieving a sustainable development of the natural resources through an integration of all the activities in the particular area:

Participation

Development, use and management of the water and coastal resources should be based on a participatory stakeholder approach, involving authorities, users and their

supporting organizations at all levels. Participation only takes place when there is real involvement in the decision-making processes. Effective participation has to come about through an organized group that is part of this decision-making process. Participation is an instrument that can be used to pursue an appropriate balance between a top-down and a bottom-up approach in ICARM. This is required because centralized, sectoral, and narrow approaches to resources management have often proved insufficient to address the fundamental issues.

Sustainability

Sustainability in this context means that the resources should be managed in a way that does not compromise future generations' use of the same resource. Management must be done in such a way that the various sectors' activities are controlled taking into account that the carrying capacity of the resources will not be exceeded and that the quality is not compromised. This implies that the management objectives should be guided by an ecosystem focus that allows economic and social development under sustainable conditions rather than by rigid environmental standards and regulations.

Integration

Integration is a central concern in management of natural resources due to a range of characteristics:

- Resources are significantly affected by the cumulative impact of the decisions and actions taken by many local users and the concomitant decisions made by different levels of government and different governments of States.
- The management of a complex resource system almost always requires the involvement of many stakeholders at the local, provincial and national level. They are interconnected and no single provincial or national level agen-cy has total control over all, or even most, of the inputs and outputs from one system to the other.
- The resources exist in different, but inter-connected physical states and environments, which cannot be managed separately.

In the present context integration has several connotations:

- Horizontal integration of separate economic sectors, (such as water supply, agriculture, forestry, industry, fisheries, tourism, transportation).
- Vertical integration of all levels (national, province, municipality, community) of government and non-government organizations.
- A planning and management perspective which combines interactions between land, groundwater, surface water, and sea resources with respect to quality as well as quantity, and taking into account the requirements of the natural ecosystems.

The Five Management Planning Steps

Ideally, the management planning process comprises five steps:

1. Identification of key management issues and problems, and their root causes
2. Establishment of management objectives, goals and targets to address the problems and their causes

3. Identification of effective and affordable priority activities – from a multitude of possibilities – to reach the targets
4. Implementation of these activities
5. Monitoring of progress and revision of the management plan, if – or rather when – it is needed

Numerous global, regional and national assessments, reviews and state-of-environment reports have generally provided a multitude of input to the establishment of step 1. and 2. But there are still a need to identify promising experiences and to develop models for best practice, when it comes to step 3 – and in particular step 4 and 5.

However, in the context of management systems for natural resources, environment and ecosystems, the management systems can conveniently be viewed as consisting of three complementary elements (or pillars). These elements are discussed and expanded below.

The Three Management Elements

- *The enabling environment* – the general framework of national legislation, strategies and policies, and the dissemination of information for natural resources management stakeholders. This framework constitute the "game board and the rules of the game" and enable all stakeholders to play their respective roles in the development and management of the resources.
- *The institutional roles* that allows effective interaction between various administrative levels and stakeholders. Collaborative mechanisms and "fora" are needed to facilitate the stakeholder participation
- *Management instruments*, including operational instruments for effective planning, regulation, implementation, monitoring and enforcement. With such instruments the decision-makers will be able to make informed choices between alternative actions. These choices are based on agreed policies, available resources, environmental impacts and the social and economic consequences.

The enabling environment

The Government authorities are responsible for creating the enabling environment. The enabling role of government implies that prescriptive, central approaches to the developments within the relevant sector shall be replaced by the creation of a framework within which the participatory, demand-driven sustainable development can take place. The performance of government functions is enhanced by Government authorities adopting a facilitating and arbitrating role, involving all actors having a stake in a particular issue and encouraging negotiations among actors themselves.

Policy-making, planning, resource allocation, monitoring, enforcement and conflict resolution still need to be the responsibility of government (with due participation of all stakeholders), whereas it is now recognised that it is beneficial to have government move away from the dual role as both a regulating entity and a service provider.

Legislation provides the basis for government intervention and action and establishes the context and framework for action by non-governmental entities and individuals and is thus an important element of the enabling environment. Specific laws relating to natural resources and environment have been enacted in a considerable number of countries.

In a situation of scarce resources, be it land or water, the more conflicts arise, the more important it is to have a coherent and comprehensive law in place. However, such legislation from an often fragmented and outdated legislative patchwork is a process requiring considerable time. In many cases the problem is not lack of adequate legislation but lack of political will, resources and means to enforce the existing legislation.

Access to reliable information is a key to making rational decisions. Without updated and reliable data on the state of the natural resources, the development pressures and the potential scenarios, it is not possible to induce the stakeholders to act proactively and efficiently.

The institutional framework

It is important to stress that there can be no blueprints for institutional frameworks valid for all cases. This is an area where stage of development, financial and human resources, traditional norms and other specific circumstances will play an important part in determining, what is most appropriate in a given context. It is, nevertheless, important to pay attention to institutional issues because the main difficulties faced in the formulation and implementation of policies and programmes are often the deficiency of institutional organization and lack of co-ordination. These institutions have to be considered in various geographic settings taking into account the political structure of the country and the unity of the resource in a basin or an aquifer.

One of the key institutional issues is effective co-ordination mechanism between different institutions. It should not be assumed that integration in the sense of institutional consolidation automatically leads to co-operation and co-ordination. Fragmented and shared responsibilities are a reality, but they may be addressed by effective co-ordination mechanisms. In some cases the establishment of a responsible body at the national level may be desirable for the accomplishment of natural resources management, where it could be responsible for developing policies and strategies, and for co-ordination and national planning. But regional variations and specific problems also creates the need for management coordination at State / Provincial / Regional level.

A critically important element is the integration of various sectoral views and interests in the decision-making process. The idea is to incorporate consultations and seek consensus with all relevant line ministries at all tiers of Government as well as with regional stakeholders located in different parts of a river basin or along a coastal fringe. Only this way is it possible to obtain equitable resource allocation. Putting forward, and transparent to all sectors and stakeholders, the combined demands for the resources and on the impacts on the environment will help determine what is feasible in order to achieve sustainability.

Civil society should be encouraged to participate in operational resource management. For instance, community based organizations may be made responsible for operation and maintenance of local resource use, conservation and protection. This way, there is a better chance of establishing a sense of ownership, which often is a requirement for improved and more sustainable management of assets and resources.

It is also important to establish an efficient implementation support network in the form of training and extension, finance institutions, research and development. Here the NGO's and the private business sector have a major role to play in many countries to improve the technical and managerial capacity of the managing institutions and to provide essential capital investments to help solve financial resource gaps.

Institutional capacity building

Institutional capacity building is a means of enhancing performance. In the context of resource management, capacity building is the sum of efforts to nurture, enhance and utilize the skills and capabilities of people and institutions at all levels – locally, nationally, regionally and internationally – so that they can better progress towards the broader goal. At the basic conceptual level, building capacity involves empowering and equipping people and organizations with appropriate tools and sustainable resources to solve their problems, rather than attempting to solve those problems directly.

Human resources development through training and education is a key dimension of capacity building. But if the acquired training is not to become atrophied through lack of use, it needs to be accompanied by incentives that are consistent with the broader goals of the institutions concerned. The ability of an institution to adapt to changing demands depends to a large extent upon its ability to adapt its human potential – the knowledge, perspectives and skills of its staff.

Equally important for an institution's capacity to fulfil its mandate is the proper devolution of institutional responsibilities and mandates, and clearing of overlaps and competition with other institutions' mandates, as well as proper and sustainable financing mechanisms.

Management instruments

Management methods

The management instruments are the specific methods that enable and help decision-makers to make rational and informed choices between alternative actions. These choices should be based on agreed policies, available resources, environmental impacts and the social and economic consequences. A wide range of quantitative and qualitative methods is being offered by systems analysis, operations research and management theory. These methods, combined with knowledge of economics, hydrology, hydraulics, environmental sciences, sociology and other disciplines pertinent to the problem in question are used for defining and evaluating alternative management plans and implementation schemes. The art of management is much

about knowing the available elements of the "tool box" and selecting, adjusting and applying the mix of tools appropriate to the given circumstances.

Information systems

In many countries available information about the natural resource situation is scarce, fragmented, outdated or otherwise unsuitable for management purposes. This is particularly true for water resources. Without adequate access to scientific information concerning the natural resources and the associated ecosystems it is not possible to evaluate the resource and to balance it against demands. Hence, the development of a knowledge base is a precondition for effective management. It is necessary to take stock of the resource and establish the natural limits for management.

Risk management

Risks associated with natural resources come in different shapes – usually related to extreme climatic events, public health and environmental damage. It is never possible to eliminate risks. Well-established techniques are available to undertake hazard (frequency and magnitude of events) assessments. However, such assessments, which rely heavily on science, technology and economics, neglect the question of what levels and types of risks are acceptable within civil society. This is a perceptual cultural issue that can only be addressed within participatory approaches.

From an environmental point of view the precautionary principle in risk management may be warranted. The lesson learned is that actions to avoid potential irreversible environmental damage from hazardous substances should not be postponed on the ground that scientific research has not fully proved and quantified a causal link between causes and potential damages.

Stakeholder mobilization and participation

The principle of stakeholder participation in natural resources management requires a serious effort of awareness raising among politicians, decision-makers in the relevant sector, professionals, interest groups and the public at large. In attracting the attention and support to resource management from these groups, mechanisms of communications and quality and relevance of information will be determining factors of the success of this venture. Communications and information systems should address the question of opportunity cost and trade-offs between alternative resource uses and projects and other social investments.

Concrete strategies for communication with all actors and stakeholders need to be devised. In the area of Environmental Impact Assessment there have been attempts to institutionalize public participation through, for instance public information sessions, expert panel hearings and similar methods.

Some countries have little experience in conducting natural resources management in an open and transparent manner with full public access to information. Decision-making has often been left to professionals and scientific experts whereas other stakeholders have been excluded form the process. A continuation of this approach

will be counterproductive to assuring broad participation and private sector investment in water management.

Resource allocation and conflict management

Market mechanisms may be exploited to the largest degree necessary possible, by including the true value of benefits and costs in the allocation process between competing users, But in many cases, it is difficult to establish accepted values and prices, and then social and political mechanisms have to be used for allocation. A wide range of conflict management techniques, involving consensus building for conflict prevention as well as conflict resolution, is available to assist stakeholders in their negotiation.

Regulatory instruments in management

There is a need for management instructions and rules interpreting and detailing the water legislation. If sustained by enabling laws, containing both basic substantive principles and authorization for delegation of authority and issuance of regulations, the usefulness of executive regulations lies in the fact that they – contrary to laws – can be made and amended at short notice, quickly responding to changing environmental, economic or social circumstances. It should be ensured that only executive regulations, which are enforceable, be implemented. If the existing enforcement capacity is deemed insufficient, regulations should be simplified or abandoned.

A multitude of regulatory instruments is at the disposal of authorities in setting up appropriate management structures and procedures. These fall into three main groups:

1. Direct command and control approaches, which may function in highly regulated societies with efficient enforcement agencies
2. Economic instruments, which may function if, fair incentives or dis-incentive can be developed.
3. Voluntary agreements and self-regulation, which may function if sufficient awareness is established, and if actions a feasible in the given socio-economic and cultural context.

Until now most Governments have relied primarily on regulatory instruments in natural resources management – often with very limited success in the field. However, innovative economic tools and voluntary agreements may offer promising alternatives.

Improved systems for Integrated Coastal Area and River Basin Management

The main objective of ICARM is to ensure the stability and the productivity of the aquatic ecosystems in a given coastal region through a sustainable economic and social development of the region and its associated river basin.

In this context it is important to acknowledge that the conceptual development of both IWRM and ICZM already to a large extent target the intentions of Agenda 21 towards sustainable management of natural resources (although implementation often lack behind). Thus, ICARM should not be considered a "new" or "alternative"

way of management but rather a way to actively focus on the remaining issues or "the gap" which is appearing due to the history or heritage from former institutional division of responsibility. Therefore, the ICARM approach naturally promotes the introduction / implementation of both IWRM and ICZM, but adds a specific focus on promotion and facilitation of the dialogue between the freshwater and the ocean world as well as on the provision of specific solutions to the management issues of this interface.

Management element	IWRM constraints	ICZM constraints	ICARM issues
Enabling Environment	• Lack of concern for coastal waters in river basin legislation, policies and strategies • Lack of public and political awareness of the importance of coastal ecosystems and their links to river basins	• Inadequate concern for coastal ecosystems in coastal legislation and policy • Lack of public and political awareness of the importance of coastal ecosystems	• Legislation reform • Documentation of adverse impacts of river basin management • Creation of awareness of politicians, authorities and coastal user groups
Institutional Framework	• Institutional barriers exclude communication with coastal authorities • Dominant sector bias • Insufficient institutional capacity • No access and participation for coastal stakeholders in IWRM	• Insufficient interaction between land use planners and coastal water managers • Dominant sector bias • Insufficient institutional capacity	• Establishment of institutional coordination and cooperation mechanism • Capacity development in integrated taskforces
Management Instruments	• Lack of effective implementation and enforcement tools	• Lack of effective implementation and enforcement tools	• Development of implementation tools

	• Lack of stakeholder involvement and responsibility • Insufficient inclusion of the benefits of coastal ecosystems • Lack of impact assessment and planning tools	• Lack of stakeholder involvement and responsibility • Lack of impact assessment and planning tools	• Improved stakeholder involvement and responsibility • Improved Valuation of coastal ecosystems • Use of tools for integrated impact assessments

The key constraints in IWRM and ICZM to implementation of the ICARM objective need to be further identified, and priority issues for further development of ICARM shall be established. To structure this discussion, the following table includes some initial issues and concerns as a first attempt and example. A more specific and operational listing can be made focusing on specific areas and case-stories, and detailing according to the items in Section 4 as well as possible further developments hereof.

3.3 Guidance on Integrated Coastal Area and River-basin Management

12 GUIDING PRINCIPLES for policy and decision makers

Presented by Martin Adriaanse, UNEP/GPA

1. **Identify the shared issues** for river basins, coastal areas and the marine environment

River basin management is focussed on its own specific issues, as is the management of the coastal area and marine environment. Some of these issues are common to rivers and coasts and necessitate an integrated approach.

2. Prioritize the shared issues and **assess the need for and benefits** of integrated management of river basins and coastal areas.

Integrated management is complex because river basins and coastal zones have different communities and separate management structures. The needs and benefits of integration should be explicit as well as the constraints that prohibit an integrated approach.

3. **Analyse cause and effect relations** for the identified issues in the river catchment and coastal area.

Pressures and driving forces behind the shared issues should be analysed, as well as the impacts on environmental or socio-economic conditions. The potential for environmental change and societal response should be explored. For shared issues the causes, effects and possible solutions may involve both river basins and coastal areas in a complex manner, making an integrated approach a prerequisite.

4. Define the spatial **problem area** for the integrated approach and **identify the stakeholders** relevant to the issues, causes and effects.

As Integrated Management of River-basin and Coastal Area (ICARM) builds on the good practices of Integrated Water Resources Management (IWRM) and Integrated Coastal Zone Management (ICZM), the focus of the integrated river-coast management should in principle be on the missing link for the shared issues. Each issue defines its own spatial problem area and needs an area specific strategic approach. A thorough stakeholder analyses should facilitate the selection of the relevant stakeholders to be involved.

5. Secure **political commitment** as an absolute prerequisite for appropriate integrated management

Broad political commitment should be built for the integrated management of shared issues for river and coast is a pre-condition for effective involvement of relevant stakeholders in dialogues and planning processes. This is especially needed to harmonize separate institutional responsibilities, legislation, regulations and management structures for river basins and coastal areas.

6. **Involve all relevant stakeholders** from the very beginning to secure their commitment.

Relevant stakeholders should be involved in a dialogue process from the identification and prioritization of issues to the analysis for management planning and decision-making. Special attention should be given to stakeholder interests and concerns, and to moderating and building consensus in the dialogues.

7. **Define goals** of the management initiative as part of a long-term perspective of the integrated management of catchment and coast.

Defined goals for the short and long term should be realistic, as unrealistic goals risk a loss of credibility. Stakeholders should be involved in the joint definition of management goals. Indicators for adequate evaluation of the developments should be defined.

8. Establish a **common knowledge and information platform** as a major tool for participatory planning processes.

Lack of information is a key impediment to public participation. Sometimes information is abundant, but scattered and access is lacking. A knowledge platform should be specific to the socio-economic conditions of the region and should optimally provide for transparency of information.

9. Facilitate **knowledge and awareness raising** at all relevant levels to create optimal conditions for a participatory approach.

Awareness raising on freshwater-coast interactions and knowledge building about the benefits of integrated management are needed to create involved stakeholders and build support for positive institutional, legislative and regulatory change.

10. Create an **enabling environment** for the management of river and coast to achieve sustainable solutions at national, river basin and local level.

Governments should be challenged to set the integrated policies and legislation that constitutes the 'rules of the game' and enable all stakeholders to play their respective roles in the context of joint management of the river basin and coastal area.

11. Encourage coastal and freshwater management **institutions to make arrangements** for an integrated approach of relevant aspects of management of catchment and coast.

Integrated management does not necessary imply the integration of institutions. It does however require coordinated strategic, administrative and institutional cooperation at local, national and international levels, through the establishment of basin committees, or other cooperative bodies to address the practical issues of integrated management of the river basin and coastal area.

12. Ensure adequate **resources and capacity** to secure successful implementation and sustainability of integrated management of catchment and coast.

People, facilities and funds are essential for proper and full implementation and management stability. Collaborative initiatives on financing between river basin and coastal and marine management authorities can help avoid competition and mutually reinforce sustainability.

4. ICARM Cases

Introduction

A 'case' should be considered a practical situation where interactions between the river and the coast are causing problems. A case presentation includes a description of the nature and status of these problems. Such cases should not necessarily be 'ready cases' or 'management success-stories'.

Two different types of cases may be distinguished:

a) Completed or ongoing cases where already important improvements in integrated management of river basin and coastal zone could be achieved

b) Cases where significant freshwater-coast management problems exist, but where improvement efforts still have to start. Such cases may be candidates for future pilot projects.

For cases of type a), it is important that presentations include a description of the case and its problems, actions taken and lessons learned about integrated management and information about the role and involvement of stakeholders.

For cases of type b), important aspects are the description of the freshwater-coast problems, constraints for integrated management of river basin and coastal area and an indication of possible solutions.

4.1 CASE 1: Integrated Water Resources Development and Management of Krishna Basin.

V. K Jyothi, CE (KGBO), CWC, Hyderabad.

Introduction

Krishna is one of the two largest river basins in Peninsular India. Some of the largest water resource projects in India such as Almatti, Srisailam, Nagarjuna Sagar, Tungabhadra, Ujjani, etc are located in the basin. The basin covers the states of Maharashtra, Karnataka and Andhra Pradesh. Water resource development has progressed considerably in Krishna; however, large untapped potential still exists in Godavari.

The River System

The Krishna river (Figure 1) rises in the Western Ghats at an altitude of 1337 m just north of Mahabaleswar, about 64 km from the Arabian Sea and flows from west to east through the states of Maharashtra, Karnataka and Andhra Pradesh. There are 13 major tributaries, which join the river Krishna along its 1400 km course. Among its major tributaries Ghataprabha, Malaprabha and the Tungabhadra are the principal right bank tributaries and the Bhima, the Musi and Munneru are the left bank tributaries. The Krishna is the second largest in the peninsular India. It covers an area of 258948 km^2, which is nearly 8% of the total geographical area of the country. The basin lies in the States of Maharashtra, Andhra Pradesh and Karnataka. The total population as per 1991 Census is estimated as 60.78 million. There are 25 towns with a population of more than one lakh (100,000), for example Hyderabad 29.1 lakhs, Pune 24.85 lakhs and Vijayawada 8.45 lakhs. Hubli – Dharwar, Solapur, Kolhapur, Belgaum, Sangli, Gulbarga, Davenegere and Kurnool are some of the important cities and towns in the basin. The basin receives rainfall from the Southwest monsoon between June and October with an average annual rainfall of 784 mm.

Water resource development

Before the middle of nineteenth century, there was little development of water resources of the Krishna basin. Numerous tanks and small diversions were in operation, but no

major work had been constructed. Since the early 1850s, major irrigation works have been undertaken in the basin. In the pre-plan period the Krishna Delta canal system, the Kurnool Cuddapah Canal, the Mutha Canals, the Nira Left Canal, the Vanivilas Sagar and Nira Right Canal were constructed. During the plan period, many storage and diversion projects were taken up and completed. Important among them are Tungabhadra, Ghataprabha, Nagarjuna Sagar, Malaprabha, Bhima and Bhadra. The basin is now agriculturally well developed. About 86% of surface water potential of the basin has been put to beneficial use so far. The ultimate irrigation potential from the existing and on going projects has been assessed as 4.7 Mha. Against this the potential created amounts to 3.2 Mha. The live storage capacity created is 34.5 BCM. Only 29% of ground water potential has been exploited.

The hydroelectric potential of the basin is 2997 MW at 60% load factor. Out of the total of 49 potential schemes, 17 schemes with an installed capacity of 1947 MW are in operation. Another 11 schemes with an installed capacity of 703 MW are in various stages of construction.

Nagarjuna Sagar, one of the earliest multipurpose projects taken up in the basin which provides for irrigation up to an area of 0.9 Mha and has an installed capacity of 900 MW for power generation. Upstream of Nagarjuna Sagar is Srisailam, which provides storage for an irrigated area of 0.2 Mha and has an installed capacity of 770 MW for power generation. Nagarjuna Sagar and Srisailam reservoirs are operated in tandem to meet the irrigation demands rather than power demands. Still, the system is effective in meeting energy peak loads. Strategies for irrigated agriculture should include exploitation of ground water by sinking of wells, providing drainage in major command areas and renovation of the existing large number of minor tanks.

All the available waters of Krishna basin have been committed for irrigation except 3455 MCM for westward diversion for power generation and 110 MCM for meeting the municipal needs of Hyderabad city. The provision of 110 MCM to meet municipal and industrial needs of Hyderabad has been found to be grossly insufficient to meet growing demands. One of the alternatives proposed to augment the supplies is to transfer water from the Nagarjuna Sagar – Srisailam system through a canal. Hyderabad is situated about 200 km from Srisailam and large agricultural tracts lying along the proposed canal route are also demanding water from the system for purposes of irrigation.

Hyderabad is a metropolitan city situated in the basin. Two storage reservoirs, Osmansagar and Himayat Sagar, were constructed in the 1920s to provide water to the city for its domestic and industrial use. Thus, there is a three-way competition for water in the basin between irrigation hydropower generation and municipal needs.

Chennai city is located outside the Krishna basin about 400 km Southeast of Srisailam. Each of the Krishna basin states has agreed to transfer 142 MCM of Krishna floodwaters for supply to Chennai. Here again large agricultural tracts lying enroute are demanding water for irrigation purposes.

Leaving aside the city of Hyderabad, providing municipal and industrial water supply is not a critical problem in the basin at present.

River pollution problems are also not very critical in the basin except for the stretches on Bhadra River near Kudremukh iron mining areas, on Musi River near Hyderabad due to domestic and industrial effluents of the city and on Tungabhadra due to paper and pulp mills at Bhadravati and Kumarapatnam. The BOD and coliform amounts are also becoming critical in the Krishna River between Karad to Sangli, Dhom dam to Narso Babri in Maharashtra and from Nagarjuna Sagar dam to Repella in Andhra Pradesh. Flood problem in Krishna is mainly due to drainage congestion in the delta area.

Water Disputes

Krishna is an interstate river. The basin states had been making proposals for development of water resources within their state boundaries. Memoranda of agreements for apportioning available waters and settling conflicting claims were drawn up at various inter-state conferences. However, these were not ratified by all the basin states. With the reorganization of state boundaries under the State Reorganization Act 1956, new states replaced the old ones. Disputes between states over utilization of waters grew bitter. Attempts made by the Central Government to settle the disputes did not succeed.

Though water is a state subject, Article 262 of the Constitution authorizes Parliament to pass laws providing for adjudication of disputes relating to waters of inter-state rivers or river valleys:

262 (1). Parliament may by law provide for the adjudication of any dispute or complaint with respect to the use, distribution or control of the waters of, or in, any inter-state river or valley.

262 (2). Notwithstanding anything in this constitution, Parliament may by law provide that neither the Supreme Court nor any other court shall exercise jurisdiction in respect of any such dispute or complaint as is referred to in clause (1).

In exercise of the power under Article 262 (1), Parliament has passed the Inter-State Water Disputes Act 1956. Krishna water disputes were adjudicated by the Tribunal set up under the Inter-State Water Dispute Act 1956.

In 1950, when the Constitution came into force, the entire Krishna basin fell within the territories of State of Bombay, Mysore, Hyderabad and Madras. There was planning at the state and national levels for intensive development of water resources. The States of Bombay, Hyderabad and Madras proposed important schemes for utilization of Krishna waters, like the Koyna, Upper Krishna, Lower Krishna, Krishna Pennar and other projects. At an inter-state conference held at Delhi, a memorandum was drawn up apportioning the available supply of the Krishna River among the four riparian states.

The state of Mysore however refused to ratify the agreement. Extensive territorial changes were made in the Krishna basin by the Andhra State Act, 1953 and the State Reorganization Act 1956. The new states of Bombay, Mysore and Andhra Pradesh became the riparian states in place of the old States of Bombay, Hyderabad,

Mysore and Madras. In view of the extensive territorial changes, the Central Water and Power Commission drew up a scheme for re-allocation of the Krishna waters. But the scheme was not accepted by the states. An inter State conference was held on the 26–27 September 1960, but no settlement could be reached.

Between 1951 and 1960 the states concerned undertook the construction of several important major projects such as the Nagarjuna Sagar, the Musi, the Tungabhadra High Level Stage I, the Koyna Hydel Stage I, the Khadakvasla Stage I, the Ghataprabha Stage II, the Ghod and the Vir Dam.

The State Governments put more schemes forward and their aggregate demand was in excess of the available supplies. Disputes became more bitter. Objections were raised concerning Nagarjuna Sagar, Srisailam and Koyna projects.

In May 1961, the Central Government appointed the Krishna Godavari Commission, which submitted its report in August 1962. The Commission found that without further data it was not possible to determine the dependable flow accurately. They also found that the supplies available in the Krishna basin were inadequate to meet the demands of all the projects of the State Governments.

In January 1962, the Mysore Government applied to the Central Government for a reference of the disputes to the Tribunal. In June 1963 the Maharashtra Government asked for reference of the disputes to the Tribunal. The Central Government tried their best to settle the dispute by negotiations. Several inter-state conferences were held, but the dispute could not be settled. The State Governments made fresh applications for reference of the dispute in 1968 and 1969. Eventually on 10 April 1969 the Government of India constituted the Krishna Water Disputes Tribunal.

Decisions of the Tribunal

The Tribunal determined that for the purpose of this case, the 75% dependable flows of the river Krishna at Vijayawada was 2,060 TMC and considered this water as available for distribution between the states of Maharashtra, Karnataka and Andhra Pradesh.

The states of Maharashtra, Karnataka and Andhra Pradesh were allocated 565, 695 and 800 TMC of water respectively, plus the quantity of water equivalent to 7.5% of excess of the average of annual utilizations for irrigation in the Krishna river basin during the water years 1990-91, 1991-92 and 1992-93, from its own projects using 3 TMC or more annually over the utilizations for irrigation in the water year 1968-69 from such projects.

Utilizations were measured as depletion of the waters of the river Krishna in any manner whatsoever including losses of water by evaporation and other natural causes from man made reservoirs and other works without deducting in the case use for irrigation the quantity of water that may return after such use to the river. The utilizations were taken as 20% of diversions in the case of domestic and municipal water supply and 2.5% in the case of diversions for industrial use.

The utilizations for irrigation in the Krishna river basin in the year 1968-69 from projects using 3 TMC or more annually were considered as follows:

- From projects of the State of Maharashtra – 61.45 TMC;
- From projects of the State of Karnataka – 76.05 TMC; and
- From projects of the State of Andhra Pradesh – 170.00 TMC.

The Tribunal further limited the utilizations from individual sub-basins by the states out of their allotted waters. The Tribunal award superseded the various agreements by Madras, Mysore and Hyderabad regarding Krishna waters made between 1892 and 1946.

Management of water resources

The Krishna basin has an average annual potential of 78.12 BCM of which 58.0 BCM is the utilizable water resources (excluding ground water). The existing storages in the basin have a combined capacity of 34.48 BCM. The ongoing projects will add another 7.78 BCM to the storage capacity. Proposed storages have a combined capacity of 0.13 BCM. With these the basin will exhaust the available surface water resources. Ground water resource of the basin is estimated to be 26.41 BCM. After making a provision of 5.58 BCM for domestic, industrial and other uses, the ground water available for irrigation is 20.83 BCM. The present utilization from ground water resources towards irrigation is 14.50 BCM (30.39%). Thus with the completion of the ongoing projects the basin would be exhausting almost all the available water resources. However large area in the basin would continue to be water deficit. In order to meet the growing demand for water in the basin especially in the Rayalaseema area it would be necessary to import water from other surplus basins.

The National Perspective Plan

The National Water Policy has underlined the need for making water available to water short areas from other areas including transfers from one river basin to another, based on a national perspective, after taking into account the requirements of the areas / basins. The Ministry of Water Resources has prepared in 1980 a National Perspective Plan for development of the country's water resources, disregarding political boundaries of states. The National Plan is in two parts namely, (i) Development of Peninsular Rivers, which is entirely within the control of Central and State Governments and (ii) Himalayan Rivers Development which calls for cooperation of India, Nepal, Bangladesh and Bhutan.

The National Perspective Plan would be one of the greatest water development projects of the world. It envisages the construction of about 180 BCM of storages, which along with inter linking canals, will facilitate additional utilization of nearly 240 BCM of water for beneficial use in India. This will enable irrigation over an additional area of 35 Mha, comprising 25 Mha by surface water and 10 Mha by increased use of ground water, besides 34000 MW of hydropower generation, flood control and other benefits. The distinct feature of the scheme is the transfer of water essentially by gravity and only in small quantities by lift not exceeding 120 m. The technology proposed for the scheme is already known and tried successfully in India.

The Government of India has set up the National Water Development Agency (NWDA) in 1980 to carry out in depth studies in order to firm up the proposals of National Perspective Plan. Among the various links being studied by NWDA the following are the links involving the Krishna basin:

1) Mahanadi (Manibhadra) – Godavari (Dowleswaram) link to transfer 11.18 BCM of water to irrigate 0.45 Mha;

2) Godavari (Polavaram) – Krishna (Prakasam Barrage) link to transfer 5.13 BCM of water and to irrigate 0.21 Mha in Orissa and Andhra Pradesh;

3) Godavari (Inchampalli) – Krishna (Nagarjunasagar) link to transfer 16.43 BCM of water and to irrigate 0.32 Mha; and

4) Godavari (Inchampalli) – Krishna (Pulichintala) link to transfer 4.37 BCM of water and to irrigate 0.41 Mha.

After meeting the demand of Godavari and Krishna basins, the balance water is proposed to be transferred to Pennar and Cauvery basins.

Major issues in water resources development in the Krishna basin

Water resources development in the basin gained momentum with award by the Tribunal. Present utilization from surface water in Krishna, is as high as 86%. Ground water utilization in both the basins is low. It is only 23.86% in the case of Krishna and only 15.02% in the case of Godavari. There are a large number of ongoing projects in the two basins, which need to be expedited. Some of the ongoing projects in Andhra Pradesh are Nagarjuna Sagar dam, Srisailam RBC, Srisailam LBC, Telugu Ganga, PD Jurala etc.

An immediate task for the State Governments would be to expedite the completion of the ongoing projects. Ground water development also needs to be expedited to take advantage of large unexploited potential.

Another major issue is the lag between irrigation potential created and potential utilized. In Andhra Pradesh the irrigation potential created so far is 3.076 Mha from major and medium projects and 3.287 Mha from minor projects. Against this the potential utilized is 2.898 Mha and 2.989 Mha respectively. Delay in construction of distribution networks, diversion of water for domestic / industrial water supply, change in cropping pattern resulting in the adoption of crops with higher water consumption etc. are some of reasons for the gap. Action for bridging the gap is being taken through Command Area Development Authorities (CADA). Construction of field channels/water courses, land levelling/shaping, ensuring timeliness in supplies are some of the activities covered under the CADA.

Introduction of irrigation has considerably increased crop productivity. However, there is considerable scope for improving productivity. While productivity depends on agro-climatic and soil conditions, there is ample scope for increasing the productivity by way of better agricultural practices and using modern technology in irrigated agriculture.

Water management has become important now with the large-scale water development and increased utilization of water for various uses. Some of the major areas needing attention are excessive loss of irrigation water to seepage, inadequate distribution of water between head and tail reaches, poor maintenance of canal system, inadequate drainage and water logging, lack of field channels and poor maintenance where they have been constructed, improper cropping calendar and cropping pattern, poor extension services, lack of land levelling, lack of interaction with the beneficiaries and poor farmer involvement.

The present status of maintenance of irrigation projects is poor. The provision made for the upkeep of irrigation projects is not adequate and whatever provision is made is not utilized effectively. A major portion of maintenance provision is spent on the staff salaries with the result that very little is left for the actual maintenance of work. Irrigation water rates are so low that they do not even meet a part of the operation and maintenance costs. Irrigation water rates, as per the National Water Policy, are required to meet at least full operation and maintenance cost.

Formation of the Water Users Association (WUA), would help in collection of water rates and also take responsibility for distribution, operation and maintenance of the secondary and tertiary portions of the distribution network, namely below distributaries or minor head up to the farm gate. The Government of Andhra Pradesh has enacted the Andhra Pradesh Farmers Management of irrigation Systems Act 1997. The Act aims at better Operation and Maintenance (O&M), providing adequate and timely water supply, improved supply to tail end areas, farmer's involvement in irrigation management and provides a sense of ownership to farmers. WUA have been set-up at the primary level and Distributary Committees (DC) at distributary level and Project Committee (PC) at project level, under this Act. This has resulted in improved farmers satisfaction, reduced disputes, higher incomes, higher yields; good irrigation improved O&M and improved collection of water rates.

River Basin Organization

The National Water Policy of India recommends resource planning for a hydrological unit such as a drainage basin as a whole. It further recommends an appropriate organization such as a River Basin Organization at basin level.

At present there is no basin wise centralized machinery in the country to compile and analyze water related data and carry out research to determine the best development option, prioritize and allocate water, take charge of regulation and control at various points along the river and monitor water resources developments within the basin. At present the allocation of waters in Krishna is on the basis of 75% dependable flows. States make plans to utilize their share of waters. In such a scenario utilization of waters beyond 75% dependability cannot be contemplated. This leads to sub optimal development of the available water resources. Ecological and other requirements are not considered.

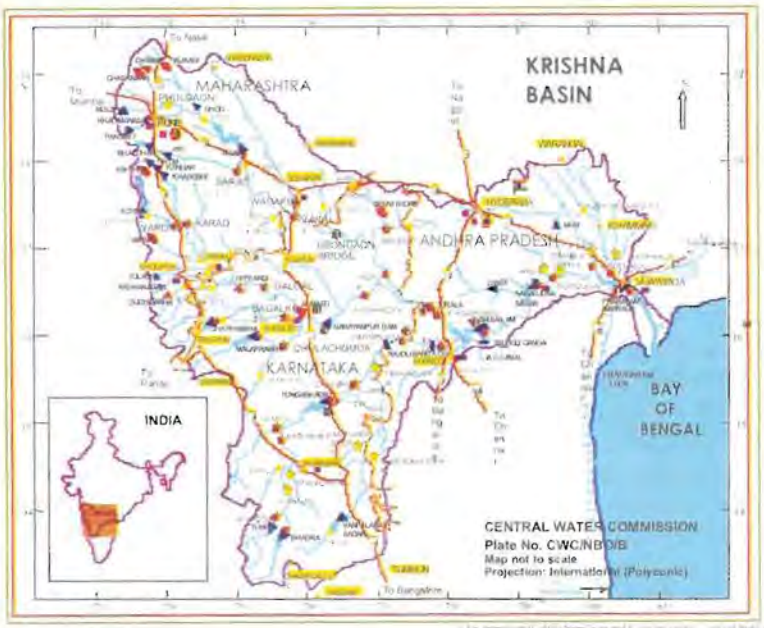
A beginning has been made in Andhra Pradesh towards the constitution of a River Basin Organization in a limited way. The RBOs will:

- Compile geo-hydrological data of the basin and determine the quantity of water available at various points in the river;
- Prepare comprehensive basin plans for water and related developments;
- Function as a coordinating agency for plans for water and related developments;
- Evolve ground water and surface water management policies, overview plans for catchment area treatment, watershed management, R&R, conservation of environment for interstate projects;
- Coordinate and direct measures for conservation and optimum utilization of water resources of interstate rivers; integrated operation of schemes for irrigation, water supply, hydro power, flood control, navigation, recreation etc; promotion of measures for prevention of water logging and salinity; conservation and up gradation of water quality, etc;
- Monitor progress of major projects and ensure due regard is given to safety and environmental protection measures; and
- Formulate and recommend policies for water management including development of cropping pattern, integrated operation of reservoirs and water budgeting in the river basins.

Conclusion

The Krishna basin is one of the two largest river basins in Peninsular India. Many large projects were taken up in these basins in the pre plan period. Water resource development gained momentum after the award of the Water Disputes Tribunal. Surface water resource of Krishna has been almost fully utilized. Krishna basin will be deficit in water resources. Inter basin transfer of water is one option for meeting the deficits in Krishna. Formation of a River Basin Organization will facilitate the integrated development and management of the water resources of the basin.

Figure 1.



4.2 CASE 2: Experiences of Water Resources Management by Mahaweli Authority of Sri Lanka.

Eng. P. Samaraweera, Executive Director- River Basin Planning and Management.

Introduction

Sri Lanka is an island in the Indian Ocean with a land area of 65,000 km^2 occupied by a population of about 18.5 million.

It has 103 distinct river basins, the majority of these rivers originating from the central highlands and flowing down to the sea. The longest river is the Mahaweli Ganga, 355 km in length that drains rainwater covering an area of 10,450 km^2, representing nearly one sixth of the island.

The rainfall pattern in Sri Lanka is dominated by two monsoons, the Southwest monsoon (May-July) and the Northeast monsoon (November-January). The annual rainfall in the country varies from 5000mm to 1500mm as shown in Figure 1.

Figure 1.

In ancient Sri Lanka there were thousands of small tanks in the dry zone. Most of these tanks were abandoned during the period of foreign domination from 1505 to 1948. Even though the average annual rainfall in Sri Lanka is around 2000 mm, most of the water resources flow to sea due to temporal and spatial variations.

In the mid 1960's Sri Lanka had number of problems such as, shortage of food, electricity, drinking water, floods, droughts, etc. The rural population had to migrate to townships and urban areas and especially to coastal zones due to water shortages. With the foreign rulers occupying the coastal stretch, development of social and physical infrastructure was concentrated in these areas.

The Mahaweli Authority of Sri Lanka (MASL) was formed in late 1970's and has been engaged in an accelerated development phase covering selected areas for land and water resources development for meeting multi-purpose objectives over a six year period from 1979 to 1986 and continued to engage in the management of special areas developed over the past one and half decades in Mahaweli and adjacent basins. The areas of development focused on the generation of hydro-power, irrigation settlement schemes that contributed to increased agricultural production, poverty reduction through socio-economic and human resource development programmes, water allocation and distribution, watershed enrichment and awareness, creation of national parks and sanctuaries, etc. The irrigation systems, dams, reservoirs and canals associated structures, etc., are managed by MASL.

Plate 1. Victoria Dam

Plate 2. Polgolla Dam

Plate 3. Bowatenna Dam

Plate 4. Randenigala Dam

The total extent of land developed for irrigated agriculture, townships and settlements under Mahaweli Development Scheme is around 325,000 ha out of which 112,000 ha were irrigable lands that represented approximately 20% of the total land extent under irrigated agriculture in the country. The total number of families settled in the above systems is 132,000.

The Mahaweli water distribution system consists of a cascade of dams, powerhouses, underground tunnels and canals in irrigation infrastructure built across natural rivers and streams. The water distribution from head-works up to tertiary canals is done by the officers of the MASL and most of the settler services are provided by MASL in special areas. The cost of operation and maintenance of the headworks, main and branch canals is met by government funds, whilst such costs associated with tertiary canals are met by the water user associations viz. Farmer Organizations established at the Distributary canal levels.

Mahaweli Development Project has catered for the conversion of large extents of under-utilized lands in the dry zone to productive assets thus contributing to resolve major issues faced by the country relating to un-employment, social infrastructure and water shortages in the dry-zone. To a great extent, most of the earlier mentioned problems have been solved, whilst some new problems have been created particularly relating to environmental concerns within and outside the special areas.

Figure 2.

Due to unplanned development efforts associated with diverse land uses particularly in the upper Mahaweli watershed areas, major reservoirs built under the Mahaweli Development Project have been subject to heavy siltation, thus leading to the reduction

of their water retention capacities. Due to sand mining in the riverbed, the ground water table has been lowered and water levels in adjacent domestic wells have been affected restricting their use. The perennial crops have also been affected due to lowering of the ground water table. Point and non-point source pollution arising from domestic / industrial waste and agro-chemicals has deteriorated the quality of river and stream water making it unusable for diverse purposes.

The unauthorized structures built inside as well as adjacent to the rivers and streams have led to the reduction of the stream and river flows and has resulted in frequent flooding during heavy storms. Due to lack of management in sand extraction activities within down stream rivers close to the sea, saline water has moved upstream of the river and the domestic water supply has been contaminated in coastal town areas. Lastly due to over pumping of ground water near the seabed for domestic purposes, saline water has moved upstream affecting adjacent lands.

To overcome these problems the power and other releases are planned in such a way to optimize the benefits of water releases by the drinking water demand along the river as well as to prevent saline water intrusion up along the river. Also planned is to construct a rubber dam near the river mouth to prevent saline water movement upstream in the river.

The Clean Rivers Programme has been initiated in several rivers as a matter of priority to resolve most of the issues associated with water quality and other natural resources impacting on the water resources.

The river basin committee was formed in one of the pilot river basins located adjacent to Mahaweli river basin viz. Kala-Oya where integrated water resources management approaches are adopted to resolve issues in the water resources sector and the natural resources impacting on water through a comprehensive planning process. Under this programme, a consultative and participatory approach is being followed for the identification of issues with the involvement of majority stakeholders representing government agencies, administrative units, water user associations such as farmer organizations, and other water users and NGOs. The World Bank funds this project, where water conservation measures are promoted through a major rehabilitation programme for irrigation infrastructure in one of the Mahaweli irrigation systems with a command area of over 31000 ha. The tertiary canal systems are being rehabilitated with part contribution from the farmers following a transparent approach involving them in decision-making. Soil samples are tested to find the exact fertilizer requirement so that pollution can be reduced while contributing to a reduction in cost of production.

The MASL has introduced innovative approaches for productivity enhancement, bulk water allocation, partial cost recovery by strengthening the farmer organizations. Several farmer companies have been established to take up business ventures. The private sector involvement in agro-business, agro-processing, high quality input supply and competitive marketing on buy back arrangements have been promoted.

Integrated Water Resources Management is a process, which promotes the coordinated development and management of water, land and related resources in

order to maximize the result and economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.
Some of the salient features of river basin planning and management approaches that are being adopted in Kala-Oya basin on a pilot basis, which are being considered for extending to Mahaweli and other river basins in the country, are described below:

- Provision for environmental flow requirements to maintain biodiversity and wetlands including wildlife parks;
- Integration of coastal resources management with comprehensive water resources plans that would enable resolution of all issues water and other natural resource related issues in the entire basin with the active participation of all stakeholders;
- Integration of surface and groundwater resource use through adoption of conjunctive use methods;
- Adoption of water sharing mechanisms through a comprehensive water resource allocation model to ensure equity in water use by offering bulk water rights at either irrigation system level or water supply scheme level or for individual bulk water users;
- Safeguarding of water rights of small water users by introducing a water permitting system for bulk water users;
- Promotion of water conservation programmes as a means to introduce demand management measures to enable the meeting of current and future growing demands in water use;
- Productivity enhancement of land and water resources by increasing the yields and extending the cropping patterns to cover high value crops catering to demand oriented production pattern, value addition through agro-processing and introducing agri-business ventures by promoting private sector to be linked to farmer based companies; and
- Facilitation of poverty reduction programmes through the provision of water meeting domestic and food requirements, whilst promoting non-farm sector income generation with a view to reduce dependence on natural resources exploitation.

The Mahaweli is beginning to adopt river basin management approaches and some of the expected benefits are to:

- Ensure equitable allocation of water resources among all basin water users while maintaining water quality and environment flows through comprehensive planning process with the participation of all basin stakeholders;
- Facilitate resolution of issues relating to water and other natural resources impacting on water through linkage of upstream and downstream basin stakeholders in the decision making process;
- To meet current and future growing demands for water conservation measures;
- Assist in promoting productivity enhancement in land and water resources, there by increasing the socio-economic status of the basin population;

- Facilitate poverty reduction programmes through the provision of water for drinking, sanitation and food needs for vulnerable groups; and
- Facilitate investment decisions for development of water resources and other sectors of the economy.

The Mahaweli Authority of Sri Lanka has been subjected to a restructuring exercise with reforms directed towards transforming it to a river basin authority that would be held responsible for management and development of the water resources for the benefit of the current and future generations with an emphasis on equitable sharing of resources among all stakeholders in Mahaweli and adjacent basins. Management of other natural resources that are impacting on water would be facilitated through effective coordinated actions by strengthening the administration units and other line agencies coupled with community driven programmes. The number of staff would be reduced with the introduction of a voluntary compensation package, whilst a selected number would be re-deployed and re-trained to perform river basin management and development functions to ensure sustainable development of natural resources, improving the quality of life of basin population.

4.3 CASE 3: Integrated Management of Rekawa Coastal Lagoon Area, River Basin of Kirama-Oya in Sri Lanka.

Dr. R. A. D. B. Samaranayake Director Coast Conservation Department Maligawatte New Secretariat, Sri Lanka.

Introduction

Sri Lanka is an island, with a land area of 64,000 km^2 and a 1585 km long coastline, lying off the southern tip of India. Rekawa, a rural coastal community, is located about 200 km South of Colombo, in the Tangalle Divisional Secretariat Area of Hambantota District. Rekawa lagoon receives most of its water from inland watersheds draining into two main rivers, Kirama Oya, 32 km long and Uru Bokka Oya, 42 km long. Kirama Oya is the principal water source for the Rekawa area with a catchment basin of approximately 225 km^2. The lagoon, which covers about 250 ha, is greatly affected by the movement and supply of water from Kirama Oya. (Fig.1 and Fig.2) Rekawa lagoon, it's water supply and flow, the fisheries, mangroves and other scrub forest with their wildlife, the agricultural land, the dynamic beach environment together with the human community are the major resources of the area. The resources comprise a complex system, the parts of which are interconnected. The trend of misuse and abuse of natural resources has increased and the requirement of an integrated management approach has been envisaged.

Problems

The main issues in Rekawa revolve around the lagoon fishery, the flow of water through Rekawa lagoon and the low productivity of agriculture in the area. The main issues in Rekawa area comprise:

Lagoon water system degradation: The lagoon water system has been degraded due to reduced freshwater flow by the irrigation structures, reduced seawater exchange in the lagoon and sedimentation and pollution of lagoon;

Lagoon and marine resources depletion: Resource depletion has increased due to over fishing of shrimp and fish, coral mining, sand mining, poaching of turtle eggs, slaughter of animals and the cutting of mangroves and scrub forest;

Shoreline and land use problems: Abandoned lands in the area have increased due to high salinity. This is because there is a lack of guidelines and zoning schemes for different developments such as tourism, aquaculture, and this has created problems;

Incidence of poverty and lack of livelihood: Due to over dependence on social welfare programmes, weak community organizations, lack of training and education for alternative employment and lack of sustainable development programmes, poverty in the area has been aggravated.

Action Taken

The Special Area Management (SAM) process, which is a locally based, geographically specific planning process, was initiated in 1993 in Rekawa. It involves the affected communities and provincial agencies in the process of resource management by building community level support through a highly participatory process and creating community based management groups.

The SAM planning process actively encourages the local community groups to participate from the beginning as a principal stakeholder in planning and implementation sessions with local and central government agencies. In this way, the local community gains a sense of "ownership" of the planning process. The resulting actions are more likely to address the most pressing issues and lead to sustainable resource use. Also, by taking a lead role in planning and management, community groups ensure that they share tangible benefits from project activities.

The overall SAM process in Rekawa is coordinated by the Rekawa Special Area Management Coordinating Committee (RSAMCC). Representative of this Committee are the Coast Conservation Department (CCD), National Aquatic Resources Agency (NARA), Irrigation Department (ID), Divisional Secretariat (DS), Tangalle Pradeshiya Sabha (PS), Hambantota Integrated Rural Development Programme (HIRDP), Department of Fisheries and Aquatic Resources Development (DFARD) and the Rekawa Lagoon and Sea Fishery Cooperative Societies.

The SAM approach is a dynamic, collaborative process involving a number of steps as mentioned below:

- Issues identification and analysis;
- Goals and objectives for resources management;
- Policy selection for resources management;
- Management strategies and actions;
- Implementation;
- Evaluation; and
- Re-adjustments to plan and implementation.

It is a flexible and on going process. The basic plan is developed early, but as circumstances change, the plan is adapted as necessary. Even during planning, implementation of preliminary small-scale projects can proceed as appropriate.

Lessons Learned

During the SAM planning process in Rekawa and other sites in Sri Lanka the following experiences have been gained and lessons learned:

- SAM process must be open, participatory and work towards consensus;
- National Government Agencies must understand and accept the process;
- Stakeholder groups must be equally represented in the management process;
- Decisions must be clear and well documented;
- Implementation results should be apparent within short periods;
- Monitoring and feedback of results makes the programme tangible;
- Community groups can make the difference in success or failure;
- In Sri Lanka cooperative management is a more appropriate concept for coastal resources management.

4.4 CASE 4: Integrated Approach to Minimize the Impact of Land Based Activities at Godavari Basin.

M. V. Ramana Murthy, Department of Ocean Development, ICMAM Project Directorate, Chennai.

Introduction

This presentation is based on the case study: 'Integrated approach to minimize impacts on estuarine ecosystem from upland activities at Godavari Delta'. The case describes how the upland activities (e.g. damming) and coastal processes (such as littoral drift) lead to the formation of an enclosed bay with mangrove ecosystems and describes methods to minimize the impacts of developmental activities at river basin and coastal areas on ecosystem.

The Godavari is the second largest estuarine in India covering an area of about 180 km^2, which supports a rich commercial fishery. The river has a drainage basin of about 3×10^5 km^2. The normal run-off of the Godavari River is about 12,888 m^3 / sec. The Godavari flows to the east and opens into the Bay of Bengal at a number of places forming an important estuarine system (Figure 1). At Dowlaiswaram, the river divides into two branches, namely, the Gautami-Godavari and the Vasishta-Godavari (Figure 1), where a masonry dam has been constructed in four sections (Ralli, Dowlaiswaram, Madduru and Vizzeswaram) across the river. Due to construction of dam, pattern in sediment supply has changed and resulted in a change in the course of the estuary. A sand spit of length 15 km extending from Guatamy Estuary is formed with Kakinada Bay, giving shelter to the growth of mangroves. The estuary receives high discharge during the months, July to October and moderate discharge from November to January, giving a varied salinity pattern. From March to May, the river discharge is almost negligible and the estuary turns to brackish water.

Figure 1. Godavari Basin and its Environs

The major activities along the Godavari estuarine system are; agriculture, shrimp culture, salt and marine chemical industries, etc. The shrimp culture industry is growing in the neighbourhood of the Godavari estuarine system by conversion of agriculture land; as a result the estuarine water system is becoming hyper saline. Construction of Kakinada Port with an offshore breakwater at the mouth leads to a decrease in the flow into the bay region, effecting water quality at the mangrove region.

Siltation and sedimentation patterns in the estuary also bring about major changes in the river course from time to time. Some existing waterways get closed abruptly after a flood, giving way to some new channels. This causes a major problem to transportation. The siltation in the brackish waters sometime leads to the destruction of breeding grounds of fish. During the times of severe floods, vast areas of agricultural lands and neighbouring villages get inundated with floodwaters. Domestic sewage released from the human settlements located on the river basin, is a major threat to the ecosystem. Damages due to cyclones and floods are more frequent in this region. Lack of scientific information on the dynamics of the Godavari Estuary is a serious limitation for management of natural resources of this region.

A pilot study taken by the Department of Ocean Development, ICMAM project directorate at Coringa Mangroves helped in quantifying the impact of port construction and sewage disposal from the human settlements. The results indicate that any further increase in the magnitude of upland developmental activities would result in complete deterioration of water quality and heath of the ecosystem. In order to regulate

upland activities and for formulation of a management plan, a detailed study covering various aspects related to socio-economics is required.

4.5 CASE 5: Integrated Coastal Resources Management Approach: A Management Tool for Coastal Habitat Management. Experiences of Managing the Coastal Wetland of Negombo, Sri Lanka.

Anil Premaratne.

Introduction

The Muthurajawela-Negombo Coastal wetland, 6,232ha in extent, is located along the western coast of Sri Lanka. The lagoon itself is 3,164ha long and is connected to the sea by a single narrow opening. The entire wetland is separated from the sea by a sand barrier formed during sea level changes in the past. The marsh, 3,068 ha in extent, extends southward from the lagoon. Freshwater from a catchment of 727 km^2 drains into the system via Dadugam Oya at the point where the lagoon and the marsh meet. The marsh-lagoon complex in its present form is estimated to have originated about 5000 years ago.

This wetland is linked both to land and sea. The volume of discharge varies seasonally with the rains and regulates variations in salinity and nutrient inflow. Tidal inflow of seawater occurs twice a day into the system. The interaction of freshwater and seawater is the fundamental process that determines the magnitude of harvestable biodiversity of the ecosystem. 75% of the aquatic animal population are transported by the tides in microscopic, floating stages into this semi-enclosed ecosystem. They grow to a harvestable stage in the nutrient rich wetland, which serves as a refuge. The main inference is that this ecosystem cannot exist independent of the sea and its biodiversity cannot be managed for sustainable use unless its connection with the sea is kept open. This marsh-lagoon wetland ecosystem must, for its continuity interact both with the terrestrial watershed and the sea.

The Muthurajawela-Negombo wetland system has provided resources like fishery, agriculture and facilitated trade and shipping much before colonization of the maritime-provinces in 1505.

Issues Affecting the Project

The issues affecting the project area can be summarized as follows:

- Sedimentation of the lagoon bed and consequent loss of fishing area;
- Difficulty to maintain adequate tidal exchange and flushing due to changes in the lagoon outlet;
- Lack of land use policy and the resultant improper use of lands;
- Discharge of untreated industrial municipal and domestic waste and effluents into the river and the lagoon water;

- Dumping of waste oil by fishing boats;
- Absence of a fixed buffer as almost all the buffer land have been reclaimed or encroached upon;
- Eutrophication of certain segments of the lagoon;
- Habitat degradation due to illegal fishing methods;
- Constant outbreak of diseases; and
- Overlapping jurisdictions and uncertainty of authority.

Management Tools used in the Negombo-Muthurajawela Special Area Management Area

The many management tools used to minimize the problems can be summarized as follows:

- A conservation management plan was prepared by the Integrated Resources Management Project (IRMP) in 1994 recommending a zoning scheme to plan-out development activities in the area;
- A Lagoon Management Authority was established to manage the fishery resource in the lagoon;
- A Community Coordinating Committee was formed in 2002 to implement development and management initiatives in the SAM area (all stakeholder groups are represented in this committee);
- All stakeholders are mobilized to participate in important meetings in the area;
- A 'Land Use Plan' was prepared;
- The Lagoon boundaries were demarcated;
- A comprehensive environmental education programme was launched; and
- In some instances legal action was taken to prevent encroachment of the lagoon water area.

Lessons Learned

- The implementation of the SAM process only commenced in early 2001 and therefore it is to soon to evaluate the impacts of these management measures. However, the following lessons were learned during the short period of implementation.
- Acquisition of state land should be done in consultation with the community in a socially equitable manner;
- Relocation of encroachers is difficult in developing countries, since the encroachers are economically marginalized communities and are politically motivated;
- Removal of obstruction to allow natural flow of the lagoon and rivers should be carried out by the communities rather than by state agencies;
- Solid waste management will only be successful if the community feel that it is their problem;

- Without proper land-use policy at regional level, catchment area management is difficult. Therefore enhancement of flood buffers and drainage capacity can be vulnerable;
- Ecosystem based fishery management system is more appropriate than national level plans; and
- Alternative employment generation programmes are very appropriate for the integrated coastal habitat management and these aspects are not in line with the national planning initiatives in many cases.

4.6 CASE 6: Integrated River Basin Management – A Pilot Project for Down Stream of the Kelani River of Sri Lanka.

L Padmini Batuwitage, Director- Ministry of Environment and Natural Resources, Sri Lanka.

Abstract

Kelani River is one of the longest rivers in the island originating from the central highlands above 1500m of the mean sea level and drains to the sea across the densely populated Western Province including the city of Colombo. This river is one of the main sources of dinking water supply for the Greater Colombo area. Apart form water supply; Kelani River supplies water for hydropower generation, industrial purposes and various other domestic uses. The water quality of some of the down stream parts of the river is getting polluted due to these multiple activities. The Ministry of Environment in 1998 selected the downstream stretch of the Kelani River, which passes across the Western Province to the coastal plain, as a Pilot Project to keep the water clean using integrated river basin management approach under the Pavithra Ganga Program. It is expected to use the experience gained by this project to keep the water bodies clean.

This pilot project is implemented in collaboration with the Department of Local Government of the Western Province, the Central Environmental Authority and other related national and provincial level institutions along with the thirteen Local Authorities located adjacent to the river. The management strategy used in this pilot project is collaborative decision making with all the stakeholders and implement the decisions separately by individual institutions based on their mandate and area of jurisdiction.

The main issues to be addressed to maintain the water quality in the project area are solid waste disposal, sewage treatment and disposal, industrial pollution, uncontrolled sand mining, bank erosion, and unauthorized constructions along the banks of the river which passes through highly urbanized areas. Actions plans were developed for the thirteen Local Authorities to address the above issues including short, medium and long term plans. Some of these plans are implemented by the Local Authorities. Implementation of some of the medium term and long term activities is hampered by lack of infrastructure facilities. Walkthrough Audits were conducted for selected industries to facilitate identification and implementation of pollution control activities.

It is evident that the water quality of the river cannot be maintained without continuous public cooperation. To secure public participation to identify the sources of pollution, it was decided to erect 24 water quality display boards at 12 sensitive locations of the Kelani River. It is also expected that the school children would use these data for their practical work as the data is updated once in two weeks, thereby children will actively participate to maintain the water quality of the river. The 13 Local Authorities are responsible for maintaining the water quality of the river under their jurisdiction in collaboration with the National and other institutions. They have already established monitoring committees with the participation of all local level participation to identify sources of pollution. If any issues cannot be addressed at Local Authority level, these will be forwarded to the Ministry for national level action. The Ministry of Environment coordinates the over all activities of the pilot project in collaboration with the other stakeholders.

4.7 CASE 7: Integration of River Basin and Coastal Processes in the Restoration of Chilika Lagoon.

Mr. A.K.Pattnaik, Chief Executive, Chilika Development Authority.

Introduction

Chilika lagoon, a Ramsar site, is situated along the east coast of India. It is the largest lagoon along the east coast of India, situated between latitude 190 28' and 190 54' N and longitude 850 05' and 850 38' E. Chilikat is a unique assemblage of marine, brackish and freshwater ecosystems. A hotspot of biodiversity, it shelters a number of endangered species found on the IUCN Red List of Threatened Species, and is a wintering ground for more than one million migratory birds. The highly productive lagoon ecosystem with its rich fishery resources sustains the livelihood of more than 0.2 million-fisher folk and the 0.8 million people who live in the catchment of the lagoon. Hydrologically, Chilika is influenced by three subsystems – the Mahanadi river system, Western catchment and the Bay of Bengal.

The lagoon has been facing multidimensional ecological and anthropogenic pressures leading to an overall loss of biodiversity and productivity and adversely affecting the livelihood of the local community who depend on the lagoon. The construction of major hydraulic structures on the major river systems and changes in the land-use pattern in the western catchment are also responsible for altering the flow pattern into the lagoon, and significantly affecting the flushing pattern. For these reasons, Chilika was added to the list of the Montreux Record of endangered wetlands in 1993 by the Ramsar Bureau.

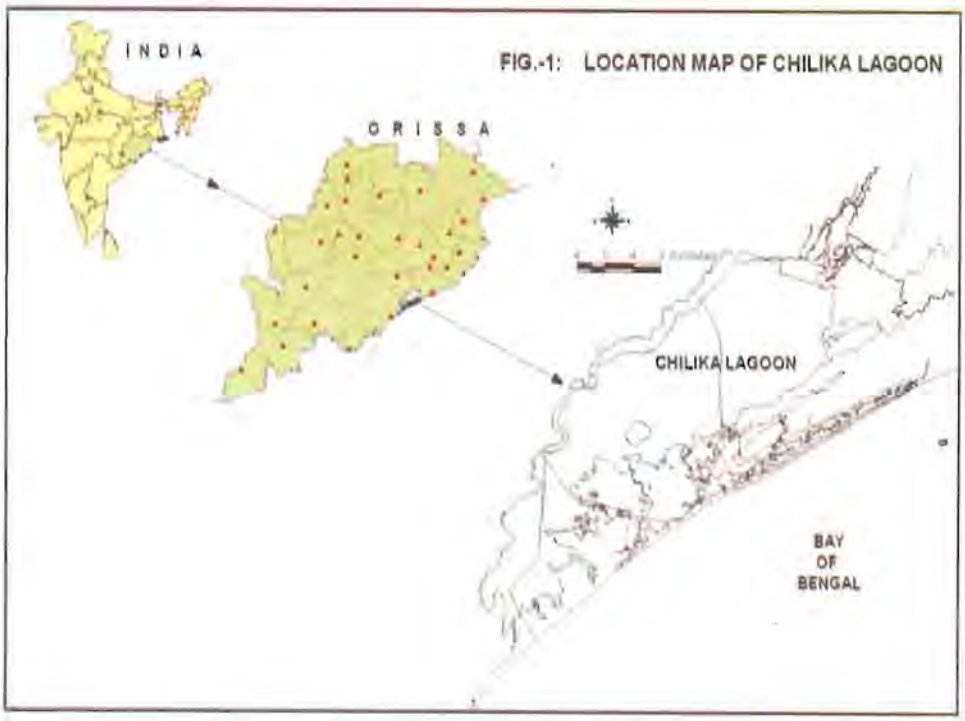
Intensive studies of the coastal processes shows that the tidal influx into the lagoon is adversely affected by the shoal formation along the lead channel and continuous shifting of the mouth due to littoral drift. This also adversely affects the natural recruitment of species through the mouth opening to the sea.

To address this problem, a straight cut was made based on the numerical model studies, bringing the mouth closer to the lagoon by 16 kilometres. After this

intervention there was a significant improvement of fishery resources due to auto-recruitment, improvement of the tidal and salinity flux into the lagoon, flushing out of sediment to the sea, the decrease of freshwater invasive species, and water logging.

A participatory approach to management of the watershed was adopted to create an enabling environment, through capacity building at the community level by means of a series of training programmes to facilitate formulation of an integrated holistic micro-plan. The objective was to facilitate appropriate land use practices by the community and to reverse degradation of life support systems – particularly land and water – leading to enhancement of productivity and thereby alleviation of poverty. Among the noteworthy aspects of the restoration model adopted by Chilika Development Authority (CDA) are the holistic approach of integration of the coastal processes and the watershed in the restoration plan; stakeholder consultation; linkages with a number of national, international institutions, NGOs, community-based organizations; and monitoring and assessment. Steps are being taken for assessment of the optimum environmental flow from the river basin and development of the appropriate infrastructure for the monitoring and modelling of coastal processes. Based on the assessment of the restoration measures taken by the Chilika development authority, the Ramsar Bureau has now removed Chilika from the Montreux Record and a prestigious Ramsar wetland award was conferred on CDA.

Figure 1. Map of Chilika Lagoon



Problems

Wetlands continue to be amongst the most threatened ecosystems in the world. Hydro geomorphology is the most dominant factor governing the ecological process and functions of a wetland. Hydrological change may affect both the biotic and abiotic components. Hydrologically, Chilika is influenced by three subsystems –the Mahanadi river system, rivers in the Western catchment and the Bay of Bengal. The construction of major hydraulic structures on the Mahanadi river system is responsible for the alteration in the flow pattern into Chilika. The long shore sediment transport along the coast of 0.1 million metric tonnes annually tends to shift the opening to the sea every year, thus adversely affecting the tidal exchange. This has significantly affected the flushing pattern and consequent natural recruitment of biological species through the opening to the sea.

The salinity level of the lagoon was observed to be decreasing alarmingly due to the choking of the inlet channel opening to the sea. The spatial and temporal salinity gradients that exist in Chilika gave it the unique characteristics of an estuarine ecosystem, exercising a continuous and selective influence on its biota. The root cause of degradation of the lagoon was identified as the alteration of the hydrological regime and over-exploitation of wetland resources. The hydrological alterations leading to the transformation of the lagoon towards a freshwater ecosystem was considered as a potential threat to its unique flora and fauna. This could be broadly attributed due to the change in the flow pattern from the catchment and the changes in the coastal processes.

For this reason the lagoon was added to the Montreux Record of endangered wetlands in 1993. The lagoon had been encountering problems from siltation due to changes in land-use patterns in the catchment, changes in the flow pattern due to the construction of the barrages upstream on the river which feeds the lagoon, choking of the inlet as well as the outlet channel connecting the sea, progressive shifting of the mouth away from the lagoon proper and a consequent decrease in the salinity gradient, proliferation of invasive species due to fall in the salinity, shrinkage of area, loss of biodiversity, depletion of fishery resources, water-logging in the peripheral agricultural lands, and an overall decline in the productivity adversely affecting the livelihood of the community depending on it. The decline in productivity also triggered certain detrimental practices like poaching of the migratory birds, over fishing, use of very small mesh size of net, felling of trees from the catchment area as a means of livelihood, etc.

Description of actions taken

As a result of its concern, the state Government created Chilika Development Authority (CDA) in the year 1992, for the purpose of restoring the lagoon. For a clear understanding of this complex system, CDA commissioned the services of the premier institutes of the country, such as the National Institute of Oceanography (NIO), to carry out a detail study of the wave climate of the inlet, long shore sediment transport along the coast and the bathymetry of the lead channel, for a clear understanding about the coastal processes. CDA is carrying out a hydro-biological monitoring of

the lagoon in collaboration with Wetlands International South Asia to understand the changes in the hydrological regimes, water quality and biota in reference to the changes in the flow pattern into the Chilika lagoon from the catchments.

It was observed from the study that the flow from the western catchments is also changing due to the change in land-use practices resulting in heavy inflow of sediment into the lagoon. Appropriate land-use and soil moisture conservation in the catchment will facilitate reduction of sediment inflow, and may also significantly enhance the productivity of lands benefiting about half a million people who live in the western catchment areas. Inadequate outflow conditions prevailing in the lagoon prevented quick disposal of floodwaters leading to water logging in agricultural fields located in the delta and northwestern periphery of the lagoon. The Central Water and Power Research Station (CWPRS), Pune, carried out the hydrological and two dimensional mathematical model studies based on the data generated from the above research. The studies concluded that the tidal influx into the lagoon was considerably reduced because of shoal formation along the lead channel and continuous shifting of the mouth that resulted in significant hydraulic head loss.

Outcomes

a) Restoration measures

Based on the findings of the numerical model studies, CWPRS concluded that the salinity flux and tidal flux into the lagoon would not improve unless the location of the opening of the inlet were brought closer to the lagoon. Following the recommendations of the CWPRS, an artificial mouth was opened on 23rd September 2000 which reduced length of the outflow channel by 18km. Desiltation of the lead channel was completed before opening the new mouth. The environment impact assessment was carried out by National Institute of Oceanography, Goa, before and after the opening of the mouth. Monitoring results indicated that there was a marked change in the water quality of the lagoon, and that the salinity flux has improved by 40% and the tidal flux by 45%.

The major rivers of Daya, Bhargavi and Luna, the distributaries of Mahanadi river system, drain in to the lagoon in the northeastern sector. These rivers annually drain about 4,385 million cubic metre of fresh water into the lagoon. The sediment loads comprising clay, silt and pebbles are mostly deposited in the river mouth as the flushing capacity of the old lead and outfall channels were very limited. Model studies by CWPRS indicated that a major portion in the northern sector adjoining to the river outfall point of Daya and Bhargabi remained a freshwater system through out the year and became infested with freshwater invasive species, adversely affecting the flow of sediment and flood water. The study advised an extension of the dredge channel from Muggermukh to the confluence point of the Daya and Bhargavi rivers to facilitate free flow of freshwater during monsoon. This would help in flushing-out the sediment into the sea, and accelerate salinity build-up in the lagoon leading to the reduction of the freshwater invasive species.

Other components of the restoration plan were the community-based treatment of the western catchment on a micro-watershed basis, restoration of Nalabana bird

sanctuary, and improvement of bird habitats with the active participation of the community. Other activities taken up by CDA included an awareness campaign and environmental education, development of a visitor center, improvement of the communication network and a research center on wetland management.

More than 0.20 million fisher folk directly depend on the lagoon, and about 0.80 people live in the catchment of the lagoon. So while formulating the management plan, stakeholder consultations were carried out by holding village level meetings to generate suggestions and recommendations for incorporation into the management action plan. The linkages with the community through the village level institutions, women's self-help groups, community-based organizations, and networking of the NGOs are included in the mandate of the CDA. A network of the NGOs and the Community Based Organizations (CBOs) working in and around the lagoon has been established.

The treatment of the catchment on a micro-watershed basis is being done in a participatory manner with an objective to facilitate a community based co-management strategy for an integrated terrestrial and aquatic resource management programme. Capacity building within the watershed community is accomplished through a series of training programmes and exposure visits, paving the way for preparation of the micro-plan, blended with indigenous knowledge for optimum utilization of the natural resources.

The watershed community also shares a part of the cost of the treatment. This creates an enabling environment for the local community to take decisions and also to understand the problem in an effective manner. A bi-monthly newsletter in local (Oriya) language is published in collaboration with a local NGO. The basic objective of the newsletter is to explain to the community about how the wetland functions, and how it's interaction with their surroundings can benefit the society. The village schoolteachers and the natural leaders who are encouraged to come up with local issues contribute most of the articles of the newsletters. A section of the newsletter is dedicated to the articles on wise use and good practices.

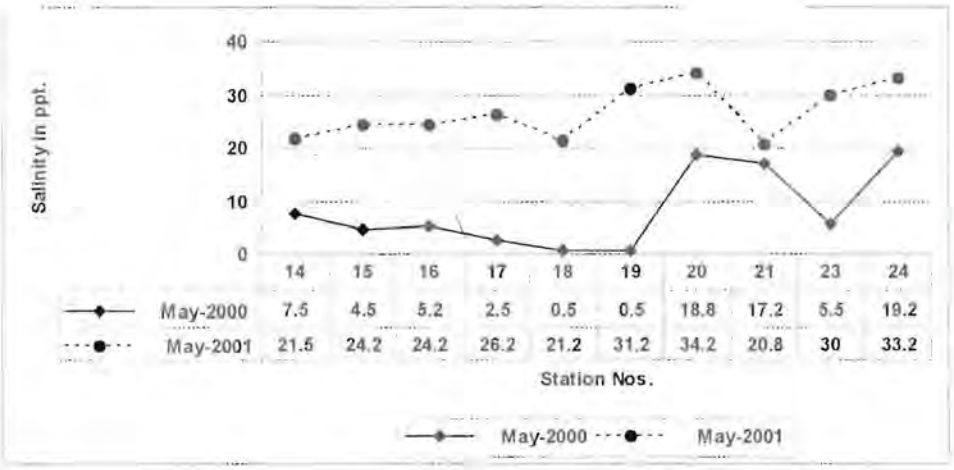
b) Impact of opening of the new mouth on the lagoon ecosystem

The opening of the artificial mouth and the desiltation of the lead channel yielded very positive results. It not only rejuvenated the ecosystem of the lagoon but also immensely benefited the community depending on the lagoon, whose average annual income increased by more than approximately US$1040 per family.

There was a significant improvement of the salinity gradient after opening of the mouth. Before this, the water of the northern sector of the lagoon remained almost fresh through out the year, and there was an abrupt change in the salinity of the central and outer channel. For an ecosystem with a seasonal and the sectoral characteristics as indicated above, an appropriate salinity gradient with gradual decrease from the lagoon mouth towards the lagoon proper is desirable. The seasonal change in salinity should not be abrupt, as it is considered, harmful for the biota. So the desirable salinity gradient should be as flat as possible.

In case of Chilika the change in salinity regime was abrupt in the outer channel and the central sector prior to opening of the mouth. After opening of the new mouth there was a marked improvement in the exchange of water between the sea and the lagoon with restoration of the salinity regime. The salinity level in the northern sector improved a lot at stations no. 17, 18 & 19 as measured during May 2001 (figure 2) against the average salinity level during the same period for the past one decade, exemplified by the May 2000 data in figure 2.

Figure 2. Variation of salinity in the Northern sector during May 2000 and May 2001



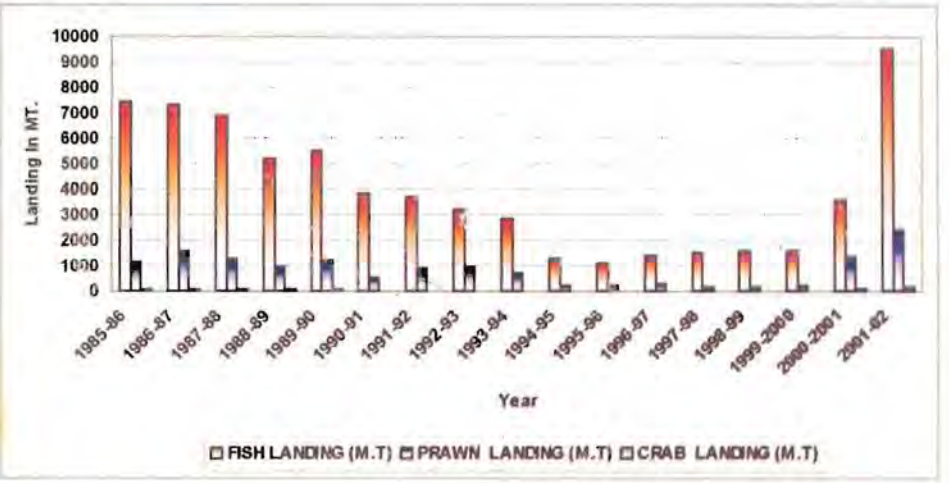
The gradual reduction in the salinity from the lagoon mouth to the lagoon interior after the opening of the mouth is providing the desirable sense of direction for the euryhaline forms to enter into the lagoon from the sea. This is facilitating the auto-recruitment of the fish, prawn and crab juvenile into the lagoon. As against the annual average fish (fish and prawns) landing of 1600 metric tons recorded during the past six years, the fish landing during the year 2000-2001 improved to 4889 metric tons (figure 3). From April 2001 to March 2002 the fish landing is recorded to be 11877 M.T, thus the average productivity during the current year has shown an increase of about 7 times in comparison to the average yield prior to opening of the mouth. Based on the average weighted price, the total financial return from the fisheries for the financial year 2001-2002 is estimated as Rs.676 million INR (nearly US$14 million).

The crab landing of the lagoon – which had declined from 79 metric tons during 1985-86 to the lowest ever, 3 metric tons during the year 1994-95 – touched 93.5 MTs in 2000-2001, and during 2001-2002 improved to 111 M.T (figure 3). After opening of the new mouth, five species of fish one species of shrimp of commercial importance reappeared which had almost disappeared from the lagoon for last two decades.

The increase in the fishery resources encouraged the community to adopt self-initiated good practices, including regulation of the mesh size, refrain from the juvenile poaching, etc. It is also providing CDA with an effective channel of communication through consultation with the community, which depends on the fishery resources of the lagoon, and facilitating the adoption of co-management strategies. The CDA and

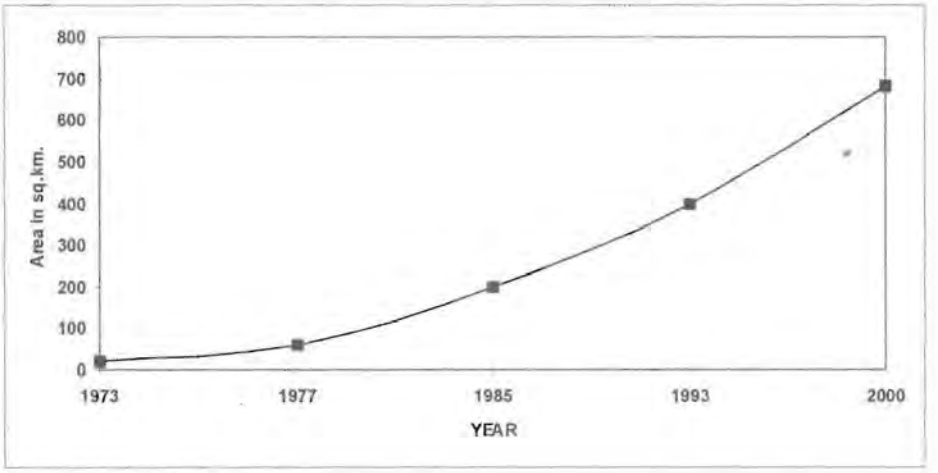
the local community are now better placed to discuss the issues and able to formulate a joint strategy through sharing and exchange of information. As an Information Education and Communication (IEC) activity, the information on wise use and good practices are communicated by CDA through regular newsletters and pamphlets in the local language.

Figure 3. Fish, prawn and crab landings of Chilika Lagoon during the years 1985-1986 to 2001-2002



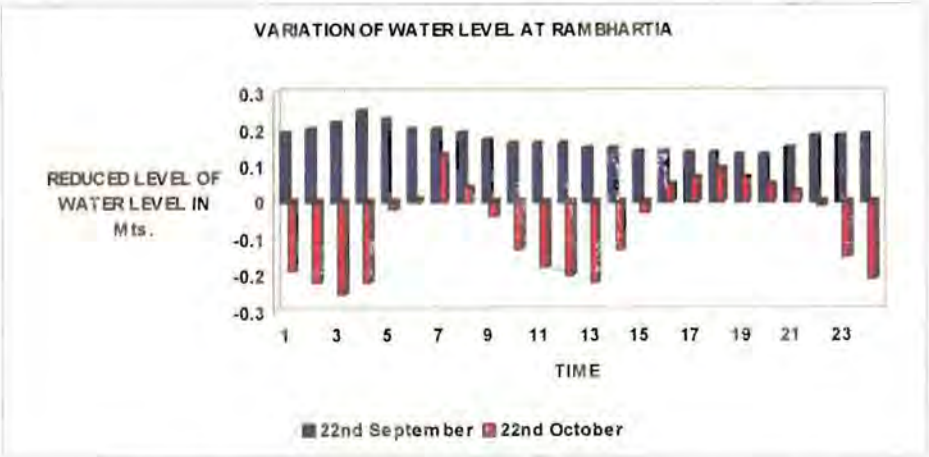
Due to fall in salinity, heavy proliferation of the freshwater invasive species took place. The weed spread area (figure 4) which was only about 20 sq.km in 1972, spread over an area of about 523 sq.km by October 2000, leaving a weed free area of bare 334 sq.km. After the opening of the new mouth, the weed free area assessed by use of the image-processing tool found to be in the order of 506 sq.km (May 2001), an increase by about 172 sq km.

Figure 4. Increase in weed spread area form the year 1973 to 2000 in the Chilika Lagoon



Due to the increase in the velocity of water and better flushing of the sediment and water to the sea through the lead and outlet channels, the depth of the channel from Satapada to the new mouth is improving progressively. There is a significant improvement in the water level variation (figure 5) during the tidal cycle leading to the pulsing which helps make the wetland more productive by providing it with nutrients and flushing out detritus and waste products.

Figure 5. Variation of water level at Rambhartia



The constrained flow through the old mouth was the root cause of the low variability of water levels in the lagoon and consequent lower drainage time that resulted in water logging in the agricultural lands of the peripheral villages around Chilika, affecting productivity in over 50,000 hectares of Khariff crop lands. The opening of the mouth facilitated a quick drainage process. In spite of the very heavy monsoon and unprecedented floods of 2001 particularly in the Mahanadi river system, the peripheral as well as island villages of Chilika were not affected due to the efficient disposal of floodwaters into the sea through the new mouth.

c) Monitoring and evaluation

Wetland functions are defined as a process or series of processes that take place within a wetland. The development of a single method for assessing the functions of wetlands or for assigning values to the functions of wetlands is not a simple task. Probably no single method will satisfy all needs. However, assessing each function of a wetland and then assigning a value to each function helps in understanding a wetland system for its better management. An evaluation system that provides the basis for comparing wetlands would facilitate mitigation of unavoidable wetland losses. It would also provide a tool for determining the success (or failure) of various interventions intended to protect or restore the wetland resources. In the case of Chilika, so far no structured assessment approach is being followed. However, the system followed in Chilika is a combination of various studies to generate the baseline information and assess the effectiveness of the various interventions made to rejuvenate the ecosystem.

The hydro biological monitoring of the lagoon is carried out to assess the impact of the barrage on the ecosystem of Chilika and to ascertain the requirement of flows to the lagoon for its sustenance. The objectives of the monitoring programme are as follows: i) identify key hydrological parameters and install equipment to monitor their changes on a long-term basis; ii) ascertain the highly erosion-prone areas of the catchment; iii) monitor the water quality of the lagoon and assess the impacts of changes in hydrological regimes on water quality; iv) develop hydrological model based on inflows, outflows, hydro-period, water balance and other key hydrological factors to predict changes in hydrological regimes; v) determine the effectiveness of various management interventions on Chilika Lagoon, particularly with reference to the salinity gradient; and vi) monitor the biodiversity in the lagoon. The other components under this monitoring programme are: a) close monitoring of the lagoon; b) assessment of phyto-diversity; and c) monitoring of the fish landing and fish stock assessment.

Considering the fragile ecosystem of the lagoon, a close monitoring of the lagoon is carried out to assess the impact of various management interventions on the lagoon. This is carried out from 30 fixed stations covering all the four ecological zones, and data collected at 30 days intervals. The monitoring programme commenced from 1996.

An exhaustive phyto-diversity survey was carried out for the collection and identification of the hydrophytes, Island plants and shoreline plants (littoral zone) of Chilika. 720 species of higher plants were identified and collected from the lagoon. Besides phytoplankton, algae, pteridophytes, and grasses were also collected during phyto diversity survey. Island-wide enumeration of the vegetation (with intensive ground truthing by use of total station and G.P.S.), ratio of vegetated areas to open water area, number of plant species, biomass, Gross Primary Production (GPP) and Net Primary production (NPP) of phytoplankton etc. are carried out every month in all four ecological sectors of the lagoon. From the monitoring it was revealed that the islands of the lagoon without habitation are the excellent sites for speciation. The other interesting outcome was the identification of 10 endemic plant species.

The remote sensing GIS tool was found to be very handy for assessment of the spread of the aquatic macrophytes in the lagoon, their distribution pattern, abundance and seasonal variation. This also proved to be very useful for monitoring of the invasive species. For the species wise classification of the macrophytes in the Chilika the digital satellite data of IRS-1D/LISS-III was used. By use of the imagery of the different seasons like post monsoon, summer and winter the weed spread area during different season was assessed. The analysis was done to understand the seasonal dynamics, the impact of various physico-chemical parameters on the abundance and distribution of the macrophytes.

CDA proposes to launch a programme for the economic evaluation of the lagoon in collaboration with the Wetlands International South Asia, with the following objectives. i) Assessment of economic contributions of products, functions and attributes of Chilika lagoon to evaluate the ecological and economic benefits derived from the

wetland; ii) assessment of community dependence and resource linkages of stakeholder groups and optimization of resource use; iii) evaluation of the impacts of development activities and ecological interventions on livelihood security and sustainability; and iv) development of strategies for ecologically and economically efficient resource management with emphasis on the livelihood security of local communities.

d) Conclusion

The hydrological interventions for the restoration of the lagoon have resulted in considerable improvement of its fishery resources and water quality and have had a positive impact on the biodiversity of the lagoon. This has significantly contributed to the increase in *per capita* income of the community, which depends on the lagoon for its livelihood. The increase in productivity of both the wetland and the watershed as a result of good environmental practices helped alleviate poverty in the community. Community participation, linkage with the various national and international institutions, and intensive monitoring and assessment systems are some of the noteworthy management practices adopted by CDA for restoration of this unique wetland. Meanwhile, time is now ripe to start a process to establish a participatory and a self-sustainable mechanism for conservation and wise-use of the resources of the Chilika lagoon on a long-term basis. An exercise for environment flow assessment is also now in progress.

Chilika has been removed from the Montreux Record by the Ramsar Bureau with effect from 11 November 2003. The prestigious Ramsar Wetland Award was also conferred on CDA for the impressive way in which the restoration was carried out with the active participation of the community.

Lessons Learned

A clear understanding of the coastal processes and the river basin provided the clue for the restoration interventions and its sustainability. Community participation is crucial for sustainability. Capacity building of the watershed community facilitated the formulation of the micro-plan at the grassroots level blended with indigenous knowledge. The micro-plan not only envisaged the appropriate land use and soil moisture conservation measures but optimum utilization of all the natural resources including the human resources in a sustainable manner.

Importance of Case

This case story demonstrates how a clear understanding of the coastal process and the river basin is essential for restoration of a coastal wetland. The intervention for improvement of the hydrological regime and the participatory management of the watershed resulted in the enhancement of the productivity thereby an increase in the *per capita* income of the community. This has also facilitated the self-initiated good practices by the community. It can be replicated in coastal wetlands, which face similar problems.

4.8 CASE 8: Coastal Zone Policies and Livelihoods in Bangladesh: A Case Study of Polder 55/1. *M. R. Miah (Only on CD-ROM).*

5. FIELD EXCURSION

A one-day field visit was made to the coastal stretch from Chennai Port to Pulicat Lake to familiarise with the issues related to ICMAM along the Chennai Coast

The coastal stretch from Chennai port to Pulicat Lake was studied extensively under the project "Development for Integrated Coastal and Marine Area Management (ICMAM) plan for Chennai". Some of the major issues of the coastal zones of Chennai are erosion, accretion, pollution and conflicting land use. A brief write up about this area is given below.

The coastal stretch from Chennai Port to Pulicat lake covers a distance of about 40km and is dominated by port activities and industrial development which have all cropped up in the recent past. The construction of Chennai port resulted in erosion of coastal land to an extent of 350 ha and river Coovum that carries domestic sewage is closed due to accreting sand South of port.

There are 10 major industries located in the Ennore-Manali area apart from 2 thermal power plants. The Ennore satellite port is located in this region. The coastal marine area is the waste disposal site for industries located here. The Ennore creek, a lifeline for both fisheries and industries experiences continuous sediment deposition at the inlet resulting in the obstruction of free tidal inflow. The development of Ennore port has resulted in erosion along the northern coast and accretion along the south breakwater. Water quality of near shore waters is affected due to disposal of solid, liquid, domestic and industrial wastes.

Pulicat Lake is the second largest brackish water lake or lagoon in India, aligned almost parallel to the Bay of Bengal. The lake extends for about 59 Km in north to south direction having a maximum width of about 19km in the east-west direction. The average depth ranges from 0.5m to 6.0m. The lake attracts a large number of migratory birds. About 80% of the 1,00,000 people in villages surrounding the lake are fishermen depending on the lake resources for their livelihood. Over fishing, decrease in lake area due to prolonged closure of the

bar-mouth, decreased tidal inflow and siltation are the major problems encountered here.

A visit to Pulicat, Royapuram erosion site and Ennore and interviews with local fishermen / coastal community / fisheries department officials and Ennore port authorities will be organised during the workshop. A 2-3 member team from ICMAM – PD, will accompany the participants and explain the ICMAM related activities.

6. Pilot Project Proposal

6.1 Pilot Project for Establishing Integrated Coastal Area and River Basin Management in South Asia: Attanagalu Oya, Sri Lanka

SUMMARY

The Attanagalu Oya River Basin is one of the most heavily populated and highly industrialized river basins in Sri Lanka. It has been shown that activities in the river basin are having significant detrimental impacts on downstream coastal wetlands with high fishery, recreational and ecological values. Therefore, it is proposed that a pilot project to be implemented for the establishment of Integrated Coastal Area and River basin Management (ICARM) in the Attanagalu Oya River Basin to ensure stability and the productivity of the aquatic systems, which in turn will be beneficial to socio-economic development of the area.

BACKGROUND

The Attanagalu Oya is located between Kelani River and Maha Oya river basins, has a catchment area of 736 km^2 and is approximately 45 km long and 35 km wide (Fig 1). The river originate from the lower peneplains of Kegalle, and flows westwards throughout its course until it meet the ancient depositional plain around Kotugoda where the river is deflected northwards before turning south to become the Danduguam Oya. Two other smaller streams, the Mapalana Oya and the Kimbulapitiya Oya drain the northwestern portion of the basin and join the main Attanagalu Oya around Madawala. The Attanagalu-Dandugam Oya finally discharges into a wetland, which is at the junction of the Negombo lagoon and Muthurajawela marsh.

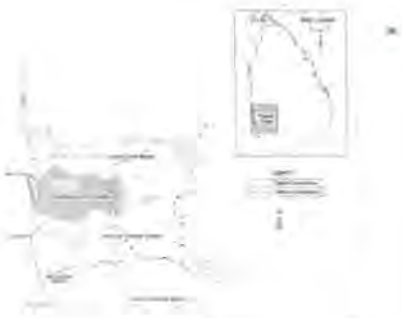


Figure 1. The Attanagalu Oya river basin
(Source: Western River Basin Sector Project)

The upper catchment of the river is approximately 250km^2, consisting of rubber and coconut estates and the lower catchment is predominantly cultivated with paddy. There is slightly over 4,000 ha of paddy irrigated under the Attanagalu Oya Irrigation Scheme, the largest irrigation project in the basin. The basin provide a home for about 5% of Sri Lanka's total population and has a population density of 1,280 persons per sq. km compared with the national average of 296 persons per sq. km.

The important water uses in the Attanagalu Oya are for the supply of drinking water and the maintenance of the Negombo lagoon and the Muthurajawela marsh, which possess high fishery, ecological and recreation values. The estimated annual value of fishery production in Negombo lagoon exceeds Rs 150 million. The lagoon and the marsh is one of the 41 wetland sites identified in the Asian Wetland Directory and has been studied under the Wetland Conservation project implemented by the Central Environmental Authority. The GOSL declared the northern section of the marsh (area of 1,777 ha) as a sanctuary in July 1996 under the Fauna and Flora Protection Ordinance.

Table 1 summarizes the major problems and issues in the basin, as identified under the ADB financed Western River Basin Sector Project.

Table 1

Issue	Causes	Effects
Water quantity • Stressed surface water resources during the dry season	Relatively small catchment area;High demand for water and uncontrolled abstrac tiõns	Reduced river flows for around 6-8 weeks of the year; Reduced dilution of pollutants; Growing competition among different users; Environmental degradation
• Flooding in the wet season	Inadequate drainage	Inundation of agricultural lands in the lower catchment
Deterioration of water quality • River water (during dry season)	Input of solid wastes; Uncontrolled shanty and slum dwellings; Increased abstractions; Sand mining	Public health risks
• Lagoon water	Excessive use of pesticides and fertilizers in agriculture; Reduced outlet from lagoon to sea	Reduced fish catch, ecological and aesthetic values

• Ground water	Input of industrial, domestic and agricultural pollutants; Over pumping of coastal aquifers	Saline intrusion in to wells and boreholes; Contamination of aquifers; Public health risks
Land use	Deforestation and inappropriate land use	Reduced infiltration and groundwater recharge; Drying up of springs
Inadequate knowledge of resources availability	Sparse coverage of hydrometric stations and infrequent monitoring;No collaboration between the different institutions dealing with various aspects of the basin.	Unreliable data base for water allocation and infrastructure development

GRDP of the Attanagalu Oya basin accounts for about 10% of the nations GDP in 1994 and the basins economy is likely to experience high growth in the coming years due to high level of industrial activity in the basin. Gampaha district, which is largely within the river basin, is already the most industrialized district in Sri Lanka.

The available water quality data from the river basin indicates high pollution levels, especially in the lower reaches. The pollution arises from the concentration of industry in the Ja-Ela and Katunayake AGA divisions, including the Katunayake EPZ and the Ekala Industrial Estate. Algal blooms are observed more frequently in the lagoon as result of phosphate inputs from the industries and agricultural runoffs, especially from the paddy cultivations. The decrease in lagoon area and the narrowing of the entrance channels at the lagoon mouth, which are a result of sedimentation and land reclamation, have decreased the tidal flushing of the lagoon. A study by Madduma Bandara et al. (1989) concluded that the lagoon had lost 25% of its surface area between 1956 and 1981.

Flooding is another major concern in the basin. The causes of flooding are heavy rainfall and the limited conveyance capacity of the main waterways discharging into the Negombo lagoon. Reclamation of low-lying areas for development, which are mainly illegal, is the major reason for flooding. Flood damage mainly affects paddy areas and a few roads while the damage is mostly caused by the long time taken for the flood to recede from inundated areas.

Previous Studies

Under the Integrated Resource Management Programme (IRMP) initiated in 1998, Negombo-Muthurajawela wetland was selected to demonstrate a replicable model in ecosystem based natural resource management of the country. The Conservation Management Plan for the area was prepared under the Wetland Conservation Project (1992-1997) and the essential elements in this Plan were the basic consideration that the local people should not be victimized by either development or conservation.

The main objectives of IRMP were:

- Poverty alleviation thereby reducing the stresses on the combined Muthurajawela Marsh and Negombo Lagoon wetland environmental and sustainable exploitation of natural resources;
- Waste management including solid and effluent waste; and
- Management of vegetation that threaten the structure and functioning of the ecosystem.

The IRMP project has identified that threats to the ecosystem of the Negombo Lagoon originate for a large part from the sources of pollution in the upstream industrial areas and part of the Attanagalu catchment area. It has recommended an integrated coastal area and river basin management effort for the conservation of this important wetland.

Key Interventions

The main goal of applying the ICARM concept is to control the loss and degradation of the environmental quality of the Attanagalu Oya river basin and coastal area and thereby improving and enhancing the livelihood of the community in the area.

To achieve this outcome the following interventions have been identified:

- Control of Sedimentation and maintenance of tidal exchange at the lagoon;
- Management of discharge of untreated industrial waste, toilet waste and other effluents;
- Improvement in hydrometric monitoring;
- Increase availability of surface water;
- Improved agricultural practices;
- Control of Illegal Lagoon Filling and Encroachment;
- Provision of a Flood Buffer; and
- Prevention of habitat degradation and over fishing.

For these activities to be effective they need to be managed within an integrated management framework. This pilot project involves the establishment of this integrated framework.

THE NEED FOR INTEGRATED COASTAL AREA AND RIVER BASIN MANAGEMENT (ICARM)

There is a need for integrated coastal area and river basin management of the Attanagalu Oya River Basin and the Muthurajawela Marsh/Negombo Lagoon coastal area. This is because:

- As identified by the IRMP, the river basin is having significant and severe impacts on the coastal system.

- There are many different government, industry and community stakeholder groups in both the river basin and coastal areas.
- There is currently no integrated management framework for the river basin and coastal systems with responsibility for various components spread between a range of government departments.
- The pressures on the river and coastal systems are likely to become increasingly severe and therefore timely and coordinated management responses are required to prevent substantial and irreversible degradation of the systems.

PILOT PROJECT – ACTIVITIES & OUTCOMES

This pilot project is to establish an ICARM framework for the Attanagalu Oya River Basin. The proposed activities are:

- An initial stakeholders meeting.
- Development of an integrated management framework.
- Specification of the monitoring & data management requirements to support the integrated management framework.
- A second stakeholders meeting to review the proposed integrated management framework.
- A review of the pilot project.

The main outputs of this pilot project will be:

- An integrated management framework.
- An integrated management committee (as a component of the framework).
- Monitoring & data management requirements established.
- An Action Plan developed by the integrated management committee.
- A review report of the pilot project.

a. Initial Stakeholders Meeting

There are many different government, industry and community stakeholder groups in both the river basin and coastal areas. These include:

- Coast Conservation Department
- Negombo Lagoon Management Authority
- District / Secretary Government Agent Gampaha
- District / Secretary Government Agent Kurunegala
- Forest Department
- Department of Wildlife Conservation
- Ministry of Lands
- Ministry of Agriculture

- Ministry of Water Resources
- Ministry of Housing
- Ministry of Industries
- NGOs
- CBOs
- Local industry

It is important that this stakeholder group is brought together in the initial instance so that the proposed pilot project can be discussed and the support of the stakeholder group obtained for its implementation.

The initial meeting of the stakeholder group will cover the following areas:

- Summary of key management issues affecting the Attanagalu Oya Basin.
- Explain the importance of ICARM in the local context.
- Introduce the key pilot project activities.
- Encourage stakeholder support and involvement and describe how they can become involved.

A field trip will be conducted to educate the stakeholders on different management issues of the river basin and the coastal areas.

b. Integrated Management Framework

The core part of the pilot project is the establishment of an integrated management framework. This will involve reviewing existing management structures and making recommendations for establishment of integrated management. This may involve the development of a mechanism(s) for better coordination of existing management structures or the establishment of dedicated integrated management body (if required). In either case, some form of "integrated management committee" will be required. Activities will be:

- *Review* – A review will be conducted of the mandate and activities of existing management bodies and structures within the river basin and coastal areas.
- *Integrated Management Framework* – Based on the outcomes of the review, a suitable model for ICARM will be developed in consultation with key stakeholders. This integrated management framework would be presented to the Sri Lankan government authorities for their consideration and approval.
- *Integrated Management Committee* – An integrated management committee will be established to oversee ICARM. The terms of reference of this committee will be documented. As part of the pilot project, the integrated management committee will develop an Action Plan for the establishment of ICARM.

It is proposed that a local consultant supervised by a team from key government departments will perform the work.

c. Monitoring & Data Management

It is critical that there are monitoring systems and data to support integrated management of the river basin and coastal areas. It may also be necessary to conduct some actual monitoring of key parameters from the previous assessment to provide an update on the status of the system. Key activities would include:

- Follow up measurements from of key parameters from the "Attanagalu Oya Basin – Detailed Basin Assessment" (1999).
- Identify on-going monitoring requirements.
- Review current monitoring programmes, data management and reporting.
- Make recommendations for ensuring that there are monitoring and data management systems to support the integrated management of the project area.
- Identify mechanisms for information and data sharing between stakeholders.

The local consultant would also manage the monitoring and data management work.

d. Second Stakeholders Meeting

A second stakeholders meeting would be held to present the integrated management framework to the stakeholder group to obtain their input and feedback. The Action Plan developed by the Integrated Management Committee would also be reviewed. There will be a discussion of the Draft Review Report and the results of this will be included in the Final Review Report.

e. Review Report

A review of the pilot study would be conducted to identify lessons learnt and the areas requiring further work.

f. Supplementary Activity

As a tangible visual outcome of the pilot project, tree-planting campaign will be conducted with the assistance of the Forest Department in identified areas to prevent soil erosion.

g. Reporting

The National Consultant will submit monthly progress reports to the South Asian Seas Secretariat (SACEP) who will in turn forward copies to UNEP's Division of Environmental Conventions (UNEP/DEC) and the GPA Office in The Hague.

BUDGET

12 Man-months

ACTIVITY	COST IN US $
Development of an integrated management framework and establishment of monitoring requirements	
• National Consultant (US $ 1500 per month – 10 man-months)	15,000
• Printing and distribution of the Reviewed Report	2,500
2 Stakeholder Meetings (US $1,000 per meeting) + Field trip	3,000
Supplementary Activities • Demarcation of flood buffer and installation of sign boards planting trees in the watershed areas to prevent soil erosion	4,500
Total	**25,000**

IMPLEMENTATION MECHANISM

This project was formulated in consultation with the concerned authorities including the Ministry of Environment & Natural Resources and the Coast Conservation Department and thus has the approval of the Government of Sri Lanka.

South Asian Seas Programme/SACEP will be overall in charge of the Project in consultation with the Ministry of Environment & Natural Resources, Department of Coast Conservation and the Negombo Project Implementation Unit of the Coastal Resources Management Project

The Negombo Project Implementation Unit of the Coastal Resources Management Project will co-ordinate all relevant agencies and will implement the project activities of the proposed pilot project. Monthly progress reports will be submitted to South Asian Seas Programme/SACEP and any technical matters would be discussed at the National Steering Committee.

The financial matters and all funds will be handled by the South Asian Seas Programme/SACEP. The National Consultant will submit monthly basic expenditure requirements and advance work programme to the SACEP Secretariat.

Establishment of two Committees at national level and local/regional level.

a) The **National Level Committee** which act as a policy making body and monitor the activities in line with the national policies on water resources management and pollution control etc will consist of the following

- The Director Coast Conservation Department
- Representative from Ministry of Environment & Natural Resources
- Director General CEA
- Director Irrigation
- D. G. Water Management Board/Authority
- D. G. Board of Investment
- Director Industries
- Conservator of Forest
- Manager of Project Implement unit Negombo

b) **The Regional Level Committee** will include all three stakeholders such as, resources managers, resource users and resources guardians.

Resource Managers

- G A Gampaha
- Regional Irrigation Engineer
- Regional Conservation of Forest (Asst. Director Forest)
- Divisional Secretary of Attanagalla, Gampaha Minuwangoda & Ja - Ela
- Regional Commissioner of Agrarian Services
- Area Manager Coast Conservation Department
- Area Manager B O I
- Industrial Ministry representatives
- C E A representatives

Resources Users

- Association of Industries of the Ekala Industrial Estate
- Gampaha District Cultivation Association
- All fisherman in the Negombo estuary
- Residents of the Raddolugama housing Scheme
- Poultry farmers, Pig Gary Owner act
- Service station owners
- Residence along the Canals and river

Resources Guardians

- Negombo Lagoon Management Authority
- Muthurajawela and Negombo Lagoon Development Foundation
- Gampaha District Media Association
- Deewara Sahayogitava
- Environment Foundation

Reference

The above proposal was prepared using a study conducted by Danish Hydraulic Institute under the Technical Assistance Project titled " Western River Basin Sector Project (TA 3030-Sri). Working Document B: Attanagalu Oya Basin: Detailed Basin Assessment, June 1999.

6.2 Project Proposal for application of Cleaner Production Practices in selected industries to maintain water quality of the downstream part of the Kelani River

OVERALL OBJECTIVE

To keep water bodies clean by using Integrated Coastal Area and River Basin Management approach.

IMMEDIATE OBJECTIVES

a) Application of Cleaner Production Practices in 50 selected industries to maintain water quality of the downstream part of the Kelani River.

b) Keep the downstream part of Kelani River clean by using Integrated Coastal Area and River Basin Management approach as a Pilot Project.

IMPLEMENTATION AGENCY

Ministry of Environment and Natural Resources

SUPPORTING AGENCIES

Small and Medium Enterprise Developers and National Cleaner production Centre

BACKGROUND

Kelani River Pavithra Ganga Program
A way forward to keep the rivers clean in Sri Lanka

The Grim state of the polluted parts of Kelani River provided the impetus to implement a pilot project with a vision to keep the rivers clean under the 'Pavitra Ganga' Program. This pilot scale program commenced in 1998, in the Western Province can be sited as an attempt for an integrated approach in river basin management.

The Ministry of Environment, in collaboration with the Western Provincial Council and with the participation of all the other stakeholders including the Central Environmental Authority and 13 Local Authorities in the Kelani River Basin worked tirelessly to achieve the common vision of to keep the down stream part of the Kelani River clean.

Kelani River is one of the largest rivers in Sri Lanka and contains some of the most densely populated districts in the country. The City of Colombo – the commercial

capital of the country, receives around 60% of potable water from the Kelani River. Upstream the river is largely clean and abounds with nature, landscape, historical and heritage assets. However, as she flows downwards, the river receives more and more pollutants from rapidly growing communities and from industries along her banks. The contribution of 13 local authorities that have the jurisdiction over these areas is of vital importance in the pilot program.

As a result of this program a number of improvements are visible. Several saw dust dumps have been removed from the riverbank and several direct domestic sewage inputs to the river has been diverted. Most of the Local authorities are now stricter on illegal constructions without sanitary facilities.

The Collaborative Approach

The main characteristic of the 'Pavithra Ganga' Program is that while the representatives of National, Provincial and Local Government level take the decisions collaboratively, the implementation is vested with individual organizations including 13 local authorities at the grass root level, which can control the sources of pollution according to their own mandate.

Ministry of Environment, with all the other stakeholders began to invest major efforts in identifying, minimizing and preventing river pollution through six identified thrust areas needing immediate improvements. The 6 areas are; solid waste management, urban development and river bank erosion, sewage disposal, water supply and drainage, industrial pollution control and natural disaster management.

A national steering committee was appointed to formulate comprehensive solutions and upon one of its recommendations, an observation tour along the Kelani River from its mouth to Avissawella (the extreme end of the Western Province) was undertaken with the participation of all stakeholders. This tour revealed a shocking status of pollution in a number of places of the river. The damage done by ad hoc buildings and by unauthorized settlements was evident in most areas due to solid waste dumping and discharge of domestic sewage. A video film was produced and displayed to raise awareness among the local authorities about the sources of pollution and other damages to the riverbank. Arrangements are being made to make the newly appointed political administration aware to facilitate implementation of the activities in the work plan by addressing the issues which have not been able to resolve so far.

Activities of Local Authorities

According to the findings of this study tour, short-term measures were taken to rectify the situation. The 13 local authorities involved in the project - Wattle Pradeshiya Sabha (Pradeshiya Sabha (PS) means a small town council), Kelaniya PS, Peliyagoda PS, Seethawaka PS, Dompe PS, Kotikawatta Mulleriyawa PS, Wattala Mabole Urban Council (UC), Kollonnawa UC, Biyagama PS, Homagama PS, Seethawaka UC, Kaduwela PS and the Colombo Municipal council (MC), drew up individual action plans as applicable to the conditions prevailing in their own areas. They were advised to take a holistic approach.

Six areas identified as needing improvement were addressed in the action plans. However, in order to establish sewage systems for populations along the river banks, the Local authorities need the support of the agencies responsible and this is one of the areas need to be looked at urgently with substantial technical and financial support.

Industrial Pollution Control

A large number of industries down stream Kelani River have been identified as polluters and on the request of the Ministry, Project SMED (Project Small and Medium Enterprise Developers) functioning under the Federation of Chambers of Commerce and Industries of Sri Lanka (FCCISL) conducted Walk Through Waste Audits for 50 industries with a view to identify main sources pollution within individual industrial processes and make recommendations on possible way forward to combat pollution by application of cleaner production methodologies. Various recommendations have been provided for these industries through which it is expected to reduce the pollution load going in to the river. The Auditors are now in the process of monitoring how these recommendations are being implemented by these industries. *However based on the experience gained during the past few years it is evident that more technical assistance is needed for the industrialists to improve their system efficiencies in collaborative manner.*

Information Boards along the river

Obtaining public participation through awareness creation was one of the major strategies of this program. Steps have been taken to put up 24 Information Boards at 12 selected sensitive locations along the river. These boards will indicate the status of the water quality of the river every two weeks.

This is the first ever instance in Sri Lanka where such a transparent environmental management measure was taken. The Central Environmental Authority, the National Water Supply and Drainage Board and the Board of Investment, Sri Lanka will alternatively collect and analyse water samples from the river, and the Local Authorities will weekly update the Information Boards with measurements of the water quality.

It is expected that these boards will assist the industrialists and the local authorities to identify sources of pollution, while providing information to the general public on the overall pollution in that location. Also it will be an opportunity for the school children to raise their analytical capacity of the water quality within the vicinity of their schools.

Monitoring committees established by the 13 Local Authorities with representatives from major stake holders including community will work together to trace sources of pollution based on the water quality data and take steps to maintain the water quality of the river under their jurisdiction. The Ministry of Environment in collaboration with the Western Provincial Council coordinated the activities of 13 Local Authorities and other stakeholders including the Department of Coast Conservation, the Central Environmental Authority and the water Supply and Drainage Board.

METHODOLOGY

The proposed project is designed as an extension of the "Cleaner Production (CP) Walk Through Audits carried out in the Kelani River program" On request of the Ministry of Environment and financial support, Small and Medium Enterprise Developers (SMED) functioning under the Federation of Chambers of Commerce and Industries - Sri Lanka (FCCISL) carried out Cleaner Production walk through audits in fifty selected industrial and business organizations with the objective of assisting these industries to identify waste streams in the processes and ways to minimize or abate. According to the audits there are many opportunities for reduction of waste, which will improve the quality and reduce the quantity of pollutants discharged or migrate to the stream connected to the Kelani River. In order to achieve full benefits of this program it is necessary to assist these industries further by carrying out a tracer study and assist them to prepare growth plans for selected best options. The SMED and the national cleaner Production Centre will carry out the tracer study in collaboration with the Ministry of Environment and Natural Resources.

MAIN ACTIVITIES

STEPS	ACTIVITIES	COST IN US $
Step 1	Carrying out a tracer study of the fifty industries by visiting the industries, Select 10 industries having most potential in terms of the CP opportunities and Conducting comprehensive audit s (If required the fifty can be from outside the programme)	750
Step 2	Conducting a CP assessor program for the selected personal from the ten industries as a Capacity building exercise	3,000
Step3	Conducting comprehensive audits (Including basic measurements) and preparation of Audit Reports	9,000
Step4	Assisting the enterprises to prepare growth plans for selected best option	2,000
Step 5	Conduct a National Seminar to present the final findings	1,500
Step 6	Establishment of a monitoring mechanism and benchmarking system to evaluate the performance of industries on application of CP	1,000
Step 7.	Preparation of a comprehensive report with recommendations based on the findings on possible national policy options and strategies to promote industries in application of cleaner production taken into consideration of socio-economic aspects.	2,000

Step 8	Development of a CD highlighting the importance of Integration of Coastal Area and River Basin Management and linkages of Industrial Pollution Control activities in the river basin to reduce the negative impacts on the coastal habitat.	4,000
	Contingencies	1,750
	TOTAL	**25,000**

DURATION OF THE PROJECT

One year

PROJECT PROPONENT

Ministry of Environment and Natural Resources

Annexes

Annex 1

Letter of Invitation

To All National Focal Points
(Bangladesh, India, Maldives, Pakistan & Sri Lanka)

UNEP / SAS
Workshop on Integrated Coastal Area and River Basin Management (ICARM)
South Asian Seas Region

UNEP in their programme support for the South Asian Seas Programme for 2003 has agreed to support the conduct of the above workshop. In order to encourage the use of regional facilities this workshop will be conducted at the NIOT Centre in Chennai, India from 7 – 10 April 2003. UNEP will provide the entire funding for the workshop.

The goal of the workshop is to train potential and actual middle level managers of river basins and coastal areas in SAS countries in the concepts, tools and processes of integrated river basin and coastal area management.

The objectives of the workshop are:

- To raise awareness of the link between river basin and coastal area issues
- To raise awareness of the benefits of integrated management of river basin and coastal area
- To identify key management elements for the ICARM approach
- To make recommendations for ICARM cases and identify potential pilot projects in the region
- To raise awareness of the international initiatives for collaboration and information exchange on ICARM
- To identify ways in which Regional Seas (SASP) and GPA could provide and support the framework for Regional Cooperation and developing Regional Strategies for ICARM

The agreed approach to the workshop will be as follows:

- Presentation and discussion on UNEP's ICARM programme and the principles of ICARM, management instruments and management processes
- National Reports on the ICARM situation and presentations of cases from each country
- Intensive discussion on these freshwater coast cases and examine possibilities if an ICRAM Pilot Project in the region
- A field trip connected to a practical ICARM case
- Presentation on thematic subjects (Legal and Political aspects, financial and incentive structures, organizational framework, conflict resolution etc) depending on the discussions following the presentations of the national cases.

The participants will consist of Inter-disciplinary groups a) Managers of river basins and coastal zones; b) Policy Makers, Planners; c) Practical Scientists. We would like to have three participants from each member country.

Further criteria for the candidates from each country are:

- At least one person who is directly involved in the management of a river basin as well as one who is involved in the management of the coastal area.
- People that work at the strategic level, meaning those who develop the concepts for what should be done and those who are involved in planning, decision making at middle level management.
- People of different disciplines that have experience with either the insurance sector, legal and institutional aspects, socio-economic aspects, innovative financing, stakeholder dialogues and/or involvement of public in decision making.

Accordingly, could you kindly make available the CV's of at least 2 nominees for each category, so that we could, in selecting the final composition of delegates from the 5 countries (1 from each category), have a wide cross section of participants from the region?

It will be appreciated if the CV's are made available to us by 24th February 2003.

SAS will cover the costs of Travel & DSA for 3 delegates from each member country.

Personal regards

Prasantha Dias Abeyegunawardene
Interim Co-ordinator
South Asian Seas Programme

Annex 2

Workshop Agenda

1st Day: Monday 7th April 2003: 09.00 Hrs to 17.00 Hrs

- Inauguration
- Introduction to Workshop
- Introduction of ICARM and the UNEP programme since 1995
- Presentation on ICARM issues, the results of the WWF3 session
- ICARM issues and last years achievements (Mr Dyhr-Nielsen, UCC-water)
- ICARM Guiding Principles (Mr Adriaanse, UNEP/GPA)
- Discussion of 2 National Cases (1.10 hour per Case: 25 min. Presentation + 45 min. discussion)
- Guatami-Godavari, India by Mr. Ramana Murthy
- Chilika Lagoon, India by Mr. A. Pattnaik

2nd Day: Tuesday 8th April 2003: 09.00 Hrs to 17.00 Hrs

- Discussion of 5 or 6 National Cases (1.10 hour per Case: 25 min. Presentation + 45 min. discussion)
  - Kelani River, Sri Lanka by Ms. P. Batuwitage
  - Kirama-Oya, Sri Lanka by Dr. R. Samaranayake
  - Negombo Lagoon, Sri Lanka by Mr. Anil Premaratne
  - Polder 55/1, Bangladesh by Mr. Nurul Haque
  - Krishna, India by Mr. V. Jyothi
  - Mahaweli, Sri Lanka by Mr. P. Samaraweera
- Conclusions on the discussion on National Cases and preparation for thematic subjects

3rd day: Wednesday 9th April – Field Visit (Full Day)

One-day field visit to familiarise with the issues related to ICMAM along the Chennai Coast Site visit.

4th Day: Thursday 10th April 2003: 09.00 Hrs to 16.00 Hrs

- Thematic Presentations on specific thematic subjects that will arise following the discussions of the National Cases.
- Discussion on possibilities for Pilot Projects and/or other future follow-up
- Conclusions

Annex 3

List of persons who spoke at the inauguration

- Mr. Mahboob Elahi, Director General, SACEP, Sri Lanka.
- Dr. Martin Adriaanse, Programme Officer, UNEP/GPA, Netherlands – Address.
- Dr. V. Sampath, Project Director, ICMAM Project Directorate, DOD, Chennai – Welcome Address.
- Prof. M. Ravindran, Director, National Institute of Ocean Technology, Chennai – Chief Guest & Inaugural Address.
- Dr. B. R. Subramanian, Advisor, Department of Ocean Development, New Delhi – Address.
- Dr. V. Krishnamurthy, Scientist-D, ICMAM-PD, Department of Ocean Development, Chennai – Vote of Thanks.

Annex 4

List of Participants

WORKSHOP ON INTEGRATED COASTAL AREA & RIVER BASIN MANAGEMENT

COUNTRY DELGATIONS

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